THE FUTURE OF AIR TRAFFIC CONTROL: THE R&D AGENDA

HEARING

BEFORE THE

SUBCOMMITTEE ON SPACE AND AERONAUTICS

COMMITTEE ON SCIENCE

HOUSE OF REPRESENTATIVES

ONE HUNDRED NINTH CONGRESS

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March 29, 2006

THE FUTURE OF AIR TRAFFIC CONTROL: THE R&D AGENDA

WEDNESDAY, MARCH 29, 2006

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON SPACE AND AERONAUTICS,
COMMITTEE ON SCIENCE,
Washington, DC.

The Subcommittee met, pursuant to call, at 2:00 p.m., in Room 2318 of the Rayburn House Office Building, Hon. Ralph M. Hall presiding.

SUBCOMMITTEE ON SPACE AND AERONAUTICS
COMMITTEE ON SCIENCE
U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, DC 20515

Hearing on:

The Future of Air Traffic Control: The R&D Agenda

March 29, 2006
2:00 p.m. – 4:00 p.m.
2318 Rayburn House Office Building

WITNESS LIST

The Honorable Jeffrey Shane
Undersecretary for Policy
U.S. Department of Transportation

Dr. Lisa Porter
Associate Administrator for Aeronautics
National Aeronautics and Space Administration

Mr. Bob Pearce
Acting Director
Joint Planning and Development Office
Federal Aviation Administration

Mr. David Dobbs
Assistant Inspector General for Aviation and Special Projects
U.S. Department of Transportation

Mr. Mike Hudson
Chairman
Committee on Technology Pathways, Assessing the Integrated Plan for NGATS
National Research Council

Dr. Gerald Dillingham
Director of Civil Aviation Issues
General Accountability Office

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HEARING CHARTER

SUBCOMMITTEE ON SPACE AND AERONAUTICS
COMMITTEE ON SCIENCE
U.S. HOUSE OF REPRESENTATIVES

The Future of Air Traffic Control: The R&D Agenda

WEDNESDAY, MARCH 29, 2006
2:00 P.M.—4:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

Purpose

On Wednesday, March 29, at 2:00 p.m., the House Science Committee's Subcommittee on Space and Aeronautics will hold a hearing to examine how research and development (R&D) are progressing on the creation of a new air traffic control system that would be able to handle three times as much air traffic as the current system can.

To oversee that R&D, Congress in 2003, created the Joint Planning and Development Office (JPDO) within the Federal Aviation Administration (FAA). JPDO was created to guide the activities of seven federal agencies, particularly the FAA and the National Aeronautics and Space Administration (NASA), as they design and implement a Next Generation Air Transportation System (NGATS, pronounced "engatz").

While the JPDO has succeeded in bringing the seven participating agencies together to discuss air traffic needs, the Office has not yet issued clear R&D objectives. Outside entities, including the General Accountability Office (GAO), the Department of Transportation's Inspector General, and the National Academy of Sciences have raised concerns about whether the JPDO as organized and funded can, over the long-term, clearly establish and enforce R&D priorities backed by sufficient budgets; integrate environmental, capacity and security concerns into the research plan; and institutionalize collaboration among agencies. (The outside reports are described in greater detail at the end of this charter.)

Witnesses

The Honorable Jeffrey N. Shane is the Under Secretary of the U.S. Department of Transportation (DOT). His duties include overseeing the JPDO.

Dr. Lisa Porter is the Associate Administrator for Aeronautics Research Mission Directorate at the NASA.

Mr. Bob Pearce is the Acting Director of JPDO.

Mr. David Dobbs is the Assistant Inspector General for Aviation and Special Projects, U.S. Department of Transportation.

Mr. Mike Hudson was Chair of the National Academy of Sciences' Committee on Technology Pathways: Assessing the Integrated Plan for a Next Generation Air Transportation System, which issued a report in 2005. He recently retired as Vice Chairman of Rolls Royce North America, a manufacturer of aircraft turbine propulsion systems.

Dr. Gerald Dillingham is Director of Civil Aviation Issues at the General Accountability Office. At the request of the Science Committee and the Transportation and Infrastructure Committee, GAO is working on a study of JPDO's structure, challenges, and international collaboration.

Overarching Questions

1. Is the JPDO effectively organized and adequately funded to plan and implement the Next Generation Air Transportation System?
2. What are the biggest near-term and mid-term technical and programmatic challenges facing the JPDO as it attempts to design and develop the NGATS? What steps can be taken to address these challenges?

3. What role should private industry (large systems integrators—for example, Boeing and Lockheed Martin—and civil air carriers) play in the design and construction of the NGATS?

Overview

Today's aviation system cannot meet the needs of the 21st century. That was the conclusion of numerous studies and blue ribbon panels, including most recently, the National Academy of Sciences and the Commission on the Future of the United States Aerospace Industry. In response to this need, the NGATS will be designed to triple the capacity of the current air traffic control system, maintain aviation's record as the safest mode of transportation, improve the level of security, and minimize the impact of weather disruptions.

To oversee the development of the NGATs, Congress in 2003 created the JPDO as part of the *"Vision 100—Century of Aviation Reauthorization Act"* (P.L. 108–176). The Act directed that JPDO be established within the FAA, and that it be led by an FAA-appointed Director[1] and a NASA-appointed Deputy Director. (The full text of the sections establishing the JPDO appear in the appendix.)

The seven federal agencies participating in the JPDO are: the Department of Transportation; the Department of Commerce—National Oceanic and Atmospheric Administration; NASA; the Department of Homeland Security; the Department of Defense; the Federal Aviation Administration; and the White House Office of Science and Technology Policy.

The JPDO is overseen by a Senior Policy Committee chaired by the Secretary of Transportation that includes senior representatives from each of the participating departments and agencies.

Issues

- *Is the JPDO giving adequate direction to its participating agencies? Are the participating agencies willing to follow the directives of the JPDO? Will the agencies have sufficient funding to devote to the NGATS?* Some of the participating agencies have expressed concern that the JPDO has not yet provided any specific R&D agenda. While the JPDO has published a "research roadmap" as required by law, that document is quite general. The JPDO plans this summer to issue an "enterprise architecture" that would provide greater detail on how the NGATS would perform, which would help agencies set their R&D agendas. At this point, therefore, it may be too early to tell how cooperative the agencies will turn out to be and whether the NGATS will proceed as a truly coordinated, coherent interagency activity. In the Science Committee version of the legislation creating the JPDO, the JPDO had its own research budget from which it could "pay" agencies to carry out specific tasks. In the final version of the Act, however, the JPDO can only request that other agencies devote their own budgets to the JPDO's suggested assignments; the JPDO's own budget just covers its coordination role.
- *How much is the U.S. going to spend on research and development? How much will NGATS cost?* No cost estimate has yet been developed and probably won't be until the architecture is established and refined, though it can be reasonably assumed that designing, researching and implementing NGATS will run into the billions of dollars. NASA has already budgeted $530 million over the next five years for research conducted by its Airspace Systems program in support of NGATS. Other agency research budgets are not known.
- *What decisions does the Senior Policy Committee have to make, and when do they have to make them, before work on the NGATS can begin in earnest?* The design of the NGATS raises policy questions as well as technical ones. Some of these policy questions need to be addressed by the Senior Policy Committee before a full research agenda can be developed. For example, the Policy Committee needs to decide if airplanes will be allowed to continue to fly under "visual flight rules" (VFR) once the NGATS is in place. VFR, which means that a pilot does not file a flight plan and just navigates using his sight rather than being guided by air traffic control, is used by small, private planes hopping from one small community airport to another. If VFR is allowed to continue, then the NGATS hardware and software will have to be much more complex because it will have to take into account smaller planes that will lack the same kinds of equipment that airlines will be using.

[1] Since its creation a little over two years ago, the JPDO has had two Directors. As of late January 2006, they are searching for a third. Mr. Bob Pearce, the NASA-appointed Deputy Director, is Acting Director.

- *Who bears the ultimate responsibility for the development of the NGATS?* The JPDO will develop the plans for the NGATS, but it cannot require any agency to carry out its plans. The FAA will operate the NGATS, but it needs other agencies, particularly NASA, to perform the R&D to develop it. The JPDO has a director, but it is overseen by the multi-agency Senior Policy Council. This complex structure is designed to ensure that all concerned agencies are "at the table" as the NGATS is developed, but who is ultimately in charge?
- *Will the development of the NGATS proceed as a true interagency effort, or will it just reflect the individual efforts of the participating agencies?* A key to answering that question may be to examine the budget process for the JPDO. Are the participating agencies going to develop a single, coherent unified budget for activities needed by the JPDO and then have that budget reviewed as a single proposal by the Office of Management and Budget? Or will activities guided by the JPDO just be budgeted and reviewed as an element of the activities of the participating agencies?
- *What role should private industry play?* The FAA typically develops detailed specifications for an air traffic control system and then invites companies to bid to build the system to FAA specs. Another option, pushed by some companies, would be for the FAA to lay out the performance requirements for a system (for example, the amount of air traffic it should be able to handle) and then allow private companies to figure out the specifics of the design. Is one method more cost-effective than the other in meeting public needs?
- *What is being done to ensure the design of NGATS is compatible with our international partners?* Large U.S. and international air carriers want to ensure that NGATS is compatible with other air navigation systems fielded around the world—especially in Europe—to avoid the huge expense of equipping their fleets with two sets of communications, navigation, and surveillance systems. The European Commission is working on its own version of a future air traffic control system that should come on line about the same time as the NGATS. Ideally, the European Commission and the JPDO will work to "harmonize" concepts of operations and equipment requirements jointly, or through the international aviation operating standards organization known as the International Civil Aviation Organization.
- *To what extent should human factors research be a part of NGATS?* An important part of designing and implementing any air traffic control system is to understand how the individuals who will be using it will deal with the technology. Therefore, human factors research, which examines the interaction between people and technology, can be an important aspect of system design. It is not clear whether human factors research (as opposed to technology R&D) is getting adequate attention in developing an R&D agenda for the NGATS. NASA has talked about reducing funding for human factors research.

Background

The Current Air Traffic Control System

Today's air traffic control (ATC) system is modeled on the concept first put into service 50 years ago: air traffic controllers, sitting in front of radar screens, guide aircraft[2] through the airspace. The process is labor intensive. From the moment an aircraft begins taxing to the runway, through takeoff, cruise, descent, landing, and taxiing to the destination terminal, pilots must receive explicit voice approval from air traffic controllers. While the introduction of computers, more powerful radars, and other modern technologies have helped controllers do their jobs with greater reliability and safety, they still must give pilots voice instructions to keep aircraft moving through the system. (Even large modern passenger aircraft do not carry radars capable of finding other, nearby planes, though, if properly equipped, some do use other technical means to permit them to "see" each other).

This year's FAA Aerospace Forecasts (for FY 2006 through FY 2017) estimates that in 2005, U.S. scheduled air carriers (mainline and regionals) boarded 738.6 million passengers on domestic and international flights. By 2017, the number of passengers is forecast to be 1.07 billion, an increase of 45 percent. The number of aircraft handled by the FAA's Air Route Traffic Control Centers are forecast to total

[2] All scheduled passenger and cargo flights, plus high-performance aircraft flying at higher altitudes, are required to use ATC services. Small general aviation aircraft can fly to and from uncrowded airports under "visual flight rules" that do not require talking to, or relying on, controllers.

47.2 million during 2006 and will grow to 67.7 million by 2017, a 43 percent increase.

Experts argue that today's system—with its reliance on ground radars, voice communications, and air traffic controllers directing each phase of flight—will not be able to accommodate enough new capacity to meet future demand. Absent a fundamental change in the operation of our ATC system, congestion will become more pervasive and, as a consequence, economic growth will become constrained.

The Next Generation Air Transportation System Concept

While no firm description of a future air traffic management system has been agreed to, it is widely accepted that NGATS will: 1) be less dependent on ground-based radars, instead relying on equipping future aircraft with electronic systems that will self-report their location (using Global Positioning technologies) to nearby aircraft and to the ground; 2) rely on systems on-board the aircraft to establish separation distances, with each plane's electronic systems "talking" to nearby aircraft, and through the use of sophisticated software, allowing aircraft to automatically determine priority of passage and separation maneuvers; 3) change the function of air traffic controllers from today's hands-on, positive-control role to a more passive one, intervening when necessary to de-conflict traffic; 4) allow more aircraft to operate in any given segment of airspace; and 5) be much more capable of forecasting weather events hours in advance, and mitigating weather impacts by increasing the flow of aircraft around them.

The Joint Planning and Development Office

The JPDO has a relatively small staff and limited resources. FAA and NASA share the cost of providing operational funding for JPDO. For FY06, FAA is providing $20 million and NASA is providing $18 million; a level that will remain fairly flat through FY11. These figures include funding for civil service and contractor employees, general and administrative expenses, support for the Integrated Product Teams (described below), and engineering studies. JPDO has a staff of approximately 100 civil servant and contractor employees (full-time equivalents).

With the exception of NASA, the proposed R&D budgets for FY07 devoted to JPDO-directed activities by participating departments and agencies have not yet been fully formulated. The budget request for NASA's Aeronautics Research Mission Directorate's (ARMD) air traffic control R&D is $120 million for FY07, gradually diminishing to $89.4 million in FY11, totaling $530 million over five years. NASA asserts, however, that many other activities in its overall aeronautics research portfolio (e.g., quieter engines; more efficient wing designs; robust flight management systems) also contribute toward the NGATS. Most of this work is performed at NASA's Ames Research Center, CA, and the Langley Research Center, VA.

On December 4, 2004, the JPDO delivered the "Next Generation Air Transportation System Integrated Plan" to Congress. (A complete copy of the plan, about 36 pages in length, can be found at *www.jpdo.aero/site_content/NGATS_v1_1204.pdf*.) It establishes high-level objectives, operational concepts, and a list of eight specific implementation strategies as key attributes of the future system. To address each strategy, an "Integrated Product Team" was formed, comprising of representatives from relevant departments and agencies, with a designated agency lead. The eight teams (with the lead agency appearing in parentheses) are:

1. Develop airport infrastructure to meet future demand. (FAA)
2. Establish an effective security system without limiting mobility or civil liberties. (DHS)
3. Establish an agile air traffic system. (NASA)
4. Establish user-specific situational awareness. (DOD)
5. Establish a comprehensive proactive safety management approach. (FAA)
6. Develop environmental protection that allows sustained aviation growth. (FAA)
7. Develop a system-wide capability to reduce weather impacts. (DOC/NOAA)
8. Harmonize equipage and operations globally. (FAA)

Vision 100 also directed the JPDO to provide Congress annual progress reports, to be submitted at the same time as the President's budget request. The first report was submitted in early March of this year. A copy can be found at *www.jpdo.aero/site_content/pdf/ngats-np_progress-report-2005.pdf*.

The JPDO also created an affiliated organization, the NGATS Institute, whose members represent other (non-federal) public and private entities having a vested interest in our nation's air transportation system. They include the Air Transport

Association; Air Line Pilots Association; Aerospace Industries Association; Airports Council International; National Business Aircraft Association; Air Traffic Control Association; plus eight others. Institute Members sit on the Integrated Product Teams, as well as provide high-level policy advice to the JPDO Director.

Outside Reports

Government Accountability Office (GAO)

The GAO is in the process of reviewing the work of the JPDO at the request of the Science Committee and the Transportation and Infrastructure Committee. So far, GAO is concerned that the JPDO may not be able to maintain the necessary interagency collaboration when it needs to begin asking participating agencies for significant spending increases. GAO points out that there is no formalized long-term agreement among the participating agencies that clearly defines their roles and responsibilities. GAO also has found that the JPDO still must convince the private sector that the government is financially committed to the NGATS, given FAA's record of starting and stopping programs.

Department of Transportation Office of Inspector General (IG)

The Inspector General is also reviewing the work of the JPDO and expects to put out a report this summer. Among the recommendations that the IG has for the JPDO are that the JPDO needs a strong leader (the position is vacant, with an acting director currently leading the organization); the JPDO needs to develop and implement mechanisms to ensure that the participating agencies will carry out assigned tasks and budget adequate funds for them; the JPDO needs to develop a strategy for technology transfer to the private sector, an area in which the FAA has a mixed record of success; the JPDO R&D agenda needs to include human factors research.

National Academy of Sciences (NAS)

The NAS report that was released last year urges the JPDO to focus first and foremost on resolving increasing the capacity of the air traffic control system, while also satisfying requirements for safety, security, environmental effects, consumer satisfaction, and industrial competition. Second, they urge the JPDO to form three Integrated Product Teams (instead of eight) focused on (1) airport operations; (2) terminal area operations; and (3) en route and oceanic operations, and to provide them, and the JPDO, with strong leadership and more full-time staff. Third, they recommend that a viable source of funding and a governance model for the NGATS be identified. Finally, the committee urges JPDO to undertake a more vigorous effort to collaborate with foreign governments and institutions to jointly fund collaborative research and to define common operational concepts.

Questions for the Witnesses

The witnesses were asked to address the following questions in their testimony:

Questions for Under Secretary Jeffrey N. Shane:

- Who is ultimately responsible for the designing and development of the Next Generation Air Transportation System (NGATS)? Given the roles of the Joint Planning and Development Office (JPDO), the Federal Aviation Administration, and the National Aeronautics and Space Administration, among others, what is being done to ensure that work on the NGATS moves ahead in a coordinated, coherent manner?
- To what extent can the JPDO move ahead with its responsibilities before the Senior Policy Council makes fundamental policy decisions—for example, how the new system will be financed, the role of pilots versus the ground in controlling aircraft, the jurisdictional line between State and federal responsibilities, and requirements for equipage? What, in your view, are the five most important unresolved policy issues that must be addressed by the Council? By what date would they have to be addressed to avoid implementation delays, and by what process will they be decided?
- How is the FAA's budget for JPDO-related research developed? Do the JPDO and its participating agencies sit down together and come up with a single unified budget that is then reviewed by OMB? Or do the agencies develop their own budgets, which are then reviewed by OMB separately?
- Should the JPDO be moved out of the Federal Aviation Administration's Air Traffic Organization to be given greater visibility and authority?
- What role will private industry play in the research, development, and implementation of the NGATS? Should the government, at some point, turn over

development of the NGATS to a large systems integrator, and if yes, at what stage might that occur?

Questions for Mr. Bob Pearce, Acting Director, JPDO

- Who is ultimately responsible for the designing and development of the Next Generation Air Transportation System (NGATS)? Given the roles of the Joint Planning and Development Office (JPDO), the Federal Aviation Administration, and the National Aeronautics and Space Administration, among others, what is being done to ensure that work on the NGATS moves ahead in a coordinated, coherent manner?
- When will the JPDO begin providing requirements and milestones to agencies for NGATS-related research and development programs? When will JPDO be able to provide a cost estimate to design, research, and build the NGATS?
- What is the process for JPDO to coordinate activities between each of the participating agencies and set research priorities? Are there sufficient resources to carry out all proposed projects?
- What steps is the JPDO taking to consult with those who will build, operate, and fly in the NGATS? To what degree will the industry's views be considered during formulation of the final design, operating, and equipage requirements?
- What do you see as the biggest near-term and mid-term technical and programmatic challenges facing the JPDO as it attempts to implement the NGATS? What steps can be taken to address those challenges?

Questions for Dr. Lisa Porter, NASA Associate Administrator for Aeronautics

- Who is ultimately responsible for the designing and development of the Next Generation Air Transportation System (NGATS)? Given the roles of the Joint Planning and Development Office (JPDO), the Federal Aviation Administration, and the National Aeronautics and Space Administration, among others, what is being done to ensure that work on the NGATS moves ahead in a coordinated, coherent manner?
- What guidance has NASA received from the Joint Planning and Development Office with respect to the types of research to be conducted by the Aeronautics Research Mission Directorate? Has NASA been able to develop a multi-year research and development plan to support NGATS-related research? Will NASA have sufficient resources to fully execute the research in a timely fashion?
- How is NASA's budget for JPDO-related research developed? Do the JPDO and its participating agencies sit down together and come up with a single unified budget that is then reviewed by OMB? Or do the agencies develop their own budgets, which are then reviewed by OMB separately?
- What do you see as the biggest near-term and mid-term technical and programmatic challenges facing the JPDO as it attempts to implement the Next Generation Air Transportation System? What steps need be taken to address those challenges?

Questions for Dr. Gerald Dillingham, General Accountability Office

- Who should be ultimately responsible for the designing and development of the Next Generation Air Transportation System? Given the roles of the Joint Planning and Development Office, the Federal Aviation Administration, and the National Aeronautics and Space Administration, among others, is enough being done to ensure that work on the NGATS moves ahead in a coordinated, coherent manner?
- What do you see as the biggest programmatic challenges facing the Joint Planning and Development Office as it attempts to implement the Next Generation Air Transportation System? What steps can be taken to address those challenges?
- To what extent does the JPDO seem to be interacting with private industry, and in your view, is the interaction productive?

Questions for Mr. Mike Hudson, National Research Council

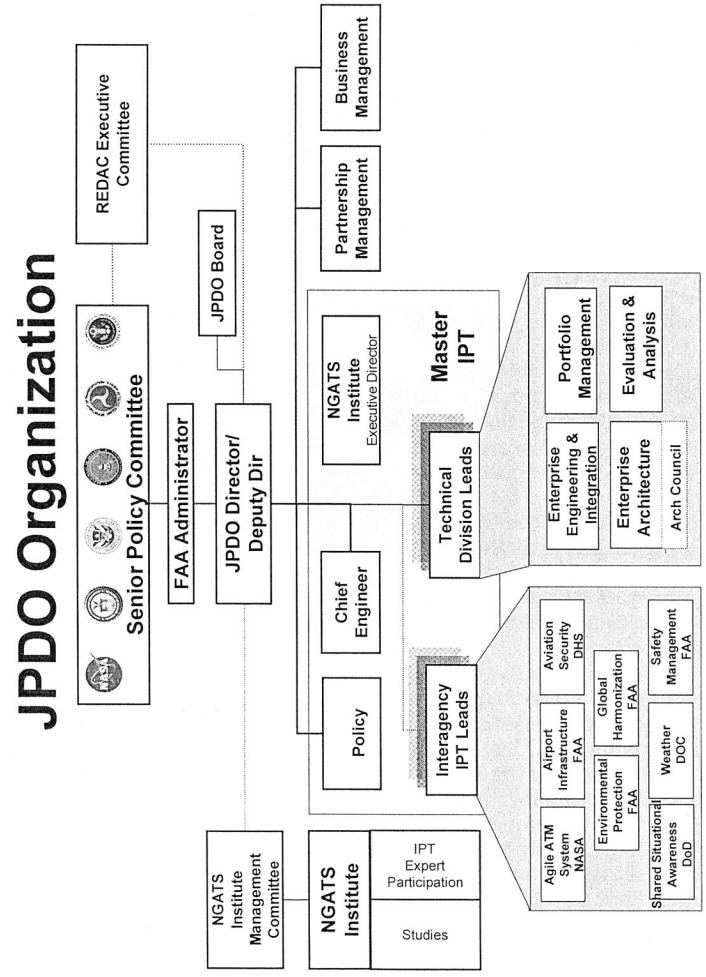
- Who is ultimately responsible for the designing and development of the Next Generation Air Transportation System? Given the roles of the Joint Planning

and Development Office, the Federal Aviation Administration, and the National Aeronautics and Space Administration, among others, what is being done to ensure that work on the NGATS moves ahead in a coordinated, coherent manner?

- What do you see as the biggest near-term and mid-term technical and programmatic challenges facing the JPDO as it attempts to implement the NGATS? What steps can be taken to address those challenges?
- How clearly does the NGATS Integrated Plan establish priorities? Are they, in your view, the right priorities?

Questions for the Honorable Todd Zinser, Acting DOT Inspector General

- Who should be ultimately responsible for the designing and development of the Next Generation Air Transportation System? Given the roles of the Joint Planning and Development Office, the Federal Aviation Administration, and the National Aeronautics and Space Administration, among others, is enough being done to ensure that work on the NGATS moves ahead in a coordinated, coherent manner?
- What do you see as the biggest near-term and mid-term technical and programmatic challenges facing the JPDO as it attempts to implement the NGATS? What steps can be taken to address these challenges?
- To what extent does the JPDO seem to be interacting with private industry, and in your view, is the interaction productive?


JPDO Organization
Senior Policy Committee
REDAC Executive Committee
FAA Administrator
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Studies
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Interagency IPT Leads
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Airport Infrastructure FAA
Aviation Security DHS
Environmental Protection FAA
Global Harmonization FAA
Shared Situational Awareness DoD
Weather DOC
Safety Management FAA

Appendix A

Appendix B

Excerpts from Title VII of H.R. 2115 (Public Law 108–176)

SEC. 709. AIR TRANSPORTATION SYSTEM JOINT PLANNING AND DEVELOPMENT OFFICE.

(a) ESTABLISHMENT—(1) The Secretary of Transportation shall establish in the Federal Aviation Administration a joint planning and development office to manage work related to the Next Generation Air Transportation System. The office shall be known as the Next Generation Air Transportation System Joint Planning and Development Office (in this section referred to as the 'Office').

(2) The responsibilities of the Office shall include—

(A) creating and carrying out an integrated plan for a Next Generation Air Transportation System pursuant to subsection (b);

(B) overseeing research and development on that system;

(C) creating a transition plan for the implementation of that system;

(D) coordinating aviation and aeronautics research programs to achieve the goal of more effective and directed programs that will result in applicable research;

(E) coordinating goals and priorities and coordinating research activities within the Federal Government with United States aviation and aeronautical firms;

(F) coordinating the development and utilization of new technologies to ensure that when available, they may be used to their fullest potential in aircraft and in the air traffic control system;

(G) facilitating the transfer of technology from research programs such as the National Aeronautics and Space Administration program and the Department of Defense Advanced Research Projects Agency program to federal agencies with operational responsibilities and to the private sector; and

(H) reviewing activities relating to noise, emissions, fuel consumption, and safety conducted by federal agencies, including the Federal Aviation Administration, the National Aeronautics and Space Administration, the Department of Commerce, and the Department of Defense.

(3) The Office shall operate in conjunction with relevant programs in the Department of Defense, the National Aeronautics and Space Administration, the Department of Commerce and the Department of Homeland Security. The Secretary of Transportation may request assistance from staff from those Departments and other federal agencies.

(4) In developing and carrying out its plans, the Office shall consult with the public and ensure the participation of experts from the private sector including representatives of commercial aviation, general aviation, aviation labor groups, aviation research and development entities, aircraft and air traffic control suppliers, and the space industry.

(b) INTEGRATED PLAN—The integrated plan shall be designed to ensure that the Next Generation Air Transportation System meets air transportation safety, security, mobility, efficiency, and capacity needs beyond those currently included in the Federal Aviation Administration's operational evolution plan and accomplishes the goals under subsection (c). The integrated plan shall include—

(1) a national vision statement for an air transportation system capable of meeting potential air traffic demand by 2025;

(2) a description of the demand and the performance characteristics that will be required of the Nation's future air transportation system, and an explanation of how those characteristics were derived, including the national goals, objectives, and policies the system is designed to further, and the underlying socioeconomic determinants, and associated models and analyses;

(3) a multi-agency research and development roadmap for creating the Next Generation Air Transportation System with the characteristics outlined under clause (ii), including—

(A) the most significant technical obstacles and the research and development activities necessary to overcome them, including for each project, the role of each federal agency, corporations, and universities;

(B) the annual anticipated cost of carrying out the research and development activities; and

(C) the technical milestones that will be used to evaluate the activities; and

(4) a description of the operational concepts to meet the system performance requirements for all system users and a timeline and anticipated expenditures needed to develop and deploy the system to meet the vision for 2025.

(c) GOALS—The Next Generation Air Transportation System shall—

(1) improve the level of safety, security, efficiency, quality, and affordability of the National Airspace System and aviation services;

(2) take advantage of data from emerging ground-based and space-based communications, navigation, and surveillance technologies;

(3) integrate data streams from multiple agencies and sources to enable situational awareness and seamless global operations for all appropriate users of the system, including users responsible for civil aviation, homeland security, and national security;

(4) leverage investments in civil aviation, homeland security, and national security and build upon current air traffic management and infrastructure initiatives to meet system performance requirements for all system users;

(5) be scalable to accommodate and encourage substantial growth in domestic and international transportation and anticipate and accommodate continuing technology upgrades and advances;

(6) accommodate a wide range of aircraft operations, including airlines, air taxis, helicopters, general aviation, and unmanned aerial vehicles; and

(7) take into consideration, to the greatest extent practicable, design of airport approach and departure flight paths to reduce exposure of noise and emissions pollution on affected residents.

(d) REPORTS—The Administrator of the Federal Aviation Administration shall transmit to the Committee on Commerce, Science, and Transportation in the Senate and the Committee on Transportation and Infrastructure and the Committee on Science in the House of Representatives—

(1) not later than one year after the date of enactment of this Act, the integrated plan required in subsection (b); and

(2) annually at the time of the President's budget request, a report describing the progress in carrying out the plan required under subsection (b) and any changes to that plan.

(e) AUTHORIZATION OF APPROPRIATIONS—There are authorized to be appropriated to the Office $50,000,000 for each of the fiscal years 2004 through 2010.

SEC. 710. NEXT GENERATION AIR TRANSPORTATION SENIOR POLICY COMMITTEE.

(a) IN GENERAL—The Secretary of Transportation shall establish a senior policy committee to work with the Next Generation Air Transportation System Joint Planning and Development Office. The senior policy committee shall be chaired by the Secretary.

(b) MEMBERSHIP—In addition to the Secretary, the senior policy committee shall be composed of—

(1) the Administrator of the Federal Aviation Administration (or the Administrator's designee);

(2) the Administrator of the National Aeronautics and Space Administration (or the Administrator's designee);

(3) the Secretary of Defense (or the Secretary's designee);

(4) the Secretary of Homeland Security (or the Secretary's designee);

(5) the Secretary of Commerce (or the Secretary's designee);

(6) the Director of the Office of Science and Technology Policy (or the Director's designee); and

(7) designees from other federal agencies determined by the Secretary of Transportation to have an important interest in, or responsibility for, other aspects of the system.

(c) FUNCTION—The senior policy committee shall—

(1) advise the Secretary of Transportation regarding the national goals and strategic objectives for the transformation of the Nation's air transportation system to meet its future needs;

(2) provide policy guidance for the integrated plan for the air transportation system to be developed by the Next Generation Air Transportation System Joint Planning and Development Office;

(3) provide ongoing policy review for the transformation of the air transportation system;

(4) identify resource needs and make recommendations to their respective agencies for necessary funding for planning, research, and development activities; and

(5) make legislative recommendations, as appropriate, for the future air transportation system.

(d) CONSULTATION—In carrying out its functions under this section, the senior policy committee shall consult with, and ensure participation by, the private sector (including representatives of general aviation, commercial aviation, aviation labor, and the space industry), members of the public, and other interested parties and may do so through a special advisory committee composed of such representatives.

Mr. HALL. [Presiding] Okay, we will call this meeting of the Space and Aeronautics Subcommittee to order, and without objection, the Chair will be granted authority to recess the Committee at any time. Hearing no objection, it is so ordered. I ask unanimous consent that the gentleman from Michigan, Mr. Ehlers, a Member of the Full Committee, but not a Member of this subcommittee, be allowed to participate in today's hearing. Is there objection? The Chair hears none; it is so ordered. Today our Chairman and our good friend, Ken Calvert, has contracted a bug and has asked me to fill in for him here. He is not seriously ill, but he doesn't feel well and I think that—and I hope he does well in the golf game, if that is where he really is. I think he is really sick.

And specifically, we are going to discuss the future of our air transportation system and specifically the research needed to realize this new system, and it is a subject that is really of great interest to me and of great importance to the American people.

In 2003, the Congress created the Joint Planning and Development Office as part of the *Vision 100—Century of Aviation Reauthorization Act.* This committee played a leading role in creating the JPDO and charged it with coordinating the design, research and implementation of a new air traffic control system that will, in the next 20 years, triple our nation's current capacity to safely move aircraft through the skies. This important joint effort includes participation from the Department of Transportation, the Department of Commerce, Defense, and Homeland Security and NASA.

Designing a new air transportation management system is an enormously complex and expensive task; thus it is vitally important that the JPDO effectively manage this program to ensure to learn continuing support and resources from its member agencies. And today we hope to hear how the JPDO and its early work on the design and development of the Next Generation Air Transportation System, called NGATS, has progressed. I think we would like to hear whether this is an effective organization or if we need to consider changes, and if so, what those changes might be.

We have a lot to learn from our witnesses and we will, I am sure, have many questions to help us understand its current state and its future challenges. I look forward to hearing from each and every one of you and I appreciate each and every one of you, and I thank you and thank you for the time back in the years past that you have worked hard to prepare yourselves to be requested to come and give this service to us, and it does take your time and it takes some of your time to get here, it takes time while you are here and it takes time to go back, but you leave with knowing the interest this Congress has is not to be evidenced by the number of Members that sit in and listen to it, because we have a record and have—the record is being taken down. It will go into the record and every Member of Congress will get a copy of it and all the Members of this, the Committee and Subcommittee, will read it and study it and use it for whatever laws we see. For you folks, we go to you who are more intelligent and more advised on the subject than we are and ask you to give us some help and we appreciate you.

So with that I am anxious to recognize the Ranking Democrat, a long-time friend of mine, a member of a very famous American family, Mr. Udall, for his statement.

[The prepared statement of Chairman Calvert follows:]

PREPARED STATEMENT OF CHAIRMAN KEN CALVERT

I want to welcome our illustrious panel today on this subject that is of great interest to me and of great importance to the American people. As we travel around the country and through the airports, all of us cannot help but notice the increasing congestion getting to the airports and through the airports. We expect the growth in demand for just domestic aviation services over the next two decades to double or triple. We need to start addressing this surge in expected demand in the next two to four years. I want to hear if we have the most effective structure in place to assure the United States' leadership role in the international marketplace for designing and manufacturing air traffic systems.

In 2003, the Congress created the Joint Planning and Development Office (JPDO) as part of the *Vision 100—Century of Aviation Reauthorization Act* (Public Law 108–176). This committee played an active role in setting up the JPDO in this legislation in defining the role of NASA, the FAA, OSTP and other agencies. Today, we hope to hear how this organization—and more importantly, the design, research and development of a Next Generation Air Transportation System (NGATS) (pronounced "en-gatz") is progressing. Is there a place in the Federal Government that this program could be managed even more efficiently and effectively? This committee has had an interest in this subject and as taken action over the years to support and to improve our air traffic management system. This system is critical to our success and to our competitiveness in the future.

Last week, at his request, I hosted in my district Congressman John Mica (R–FL), Chairman of the House Aviation Subcommittee, at a hearing on aviation congestion in the Southern California area. The hearing was very revealing and illustrated the importance of all of us working together to come up with the best system that we can develop in a timely manner.

I understand that the FAA and NASA share the cost of providing operational funding for JPDO. In this current year, the FAA will provide about $20M and NASA will provide about $18M. I would like to know if this is the most effective way to spend these funds to lead us to this next generation of airspace management.

I have expressed publicly my concern that we may not be moving out quickly enough to maintain our global leadership in this arena. We have heard that the Europeans have kicked off a major effort with industry to develop a plan for their Air Traffic Management transformation initiative, called Single European Skies, that could, if well-funded, eclipse our efforts.

With the organization that is currently in place, I would like to hear whether this is an effective organization or if we need to change it to make us more competitive and successful. For instance, if I want to call the person in charge of this effort in the Federal Government, whom do I call?

A couple of weeks ago on March 15, all the partners for JPDO hosted a day of educating folks on the Hill in our hearing room down the hall. I attended the kick-off in the morning along with Chairman Boehlert, Secretary Mineta, Administrator Blakey, and NASA Associate Administrator Lisa Porter who is on our panel today. I am glad that this program is beginning to get more visibility. We have a lot of questions today on the future of this program that is so important to our effectiveness as a partner and our success as a global leader. I look forward to hearing from our panel today.

Mr. Udall, we would be glad to hear your statement now.

[The prepared statement of Mr. Hall follows:]

PREPARED STATEMENT OF REPRESENTATIVE RALPH M. HALL

Today, our Chairman and my friend, Ken Calvert has contracted a "bug" and has asked me to fill in for him at this important hearing. I want to welcome our illustrious panel that has convened today to discuss the future of our air transportation system, and specifically the research needed to realize this new system. This is a subject that is of great interest to me and of great importance to the American people.

In 2003, the Congress created the Joint Planning and Development Office (JPDO) as part of the *Vision 100—Century of Aviation Reauthorization Act.* This committee played a leading role in creating the JPDO and charged it with coordinating the de-

sign, research and implementation of a new air traffic control system that will—in the next twenty years—triple our nation's current capacity to safely move aircraft through the skies. This important joint effort includes participation from the Departments of Transportation, Commerce, Defense, and Homeland Security, and NASA.

Designing a new air transportation management system is an enormously complex and expensive task, thus it's vitally important that the JPDO effectively manage this program to ensure it will earn continuing support and resources from its member agencies.

Today, we hope to hear how the JPDO—and its early work on the design and development of a Next Generation Air Traffic System (NGATS) (pronounced "engatz")—is progressing. We would like to hear whether this is an effective organization or if we need to consider changes, and if so, what those changes might be.

We have a lot to learn from our witnesses, and we will, I'm sure have many questions to help us understand its current state, and its future challenges. I look forward to hearing from each and everyone of you.

I now recognize the Ranking Democrat, Mr. Udall, for his opening statement.

Mr. UDALL. Thank you, Mr. Chairman. Judge Hall, it is always a tremendous honor to sit on the podium with you and——

Mr. HALL. I don't really like to sit by you because you are so doggone handsome it makes me look bad. Go ahead now. I will give you 15 minutes if you don't——

Mr. UDALL. Is this on the record, Mr. Chairman? I am speechless. I would tell you that I do believe Mr. Calvert—Chairman Calvert is ill because if he was on the golf course, I would be with him. I, too, want to join the Chairman in welcoming all of you here today for this important hearing focused on the future of our air transportation system. As I left a meeting to come over here, in mid-meeting, and I told the constituents from Colorado the subject of the hearing, they are already to get on airplanes tomorrow to fly home, so they appreciated the importance of what we are going to discuss here today.

Of course, Members of Congress were in the same—we are not in the same boat, we are in the same airplane, aren't we, Ralph, because we fly home almost on a weekly basis, and we also know how important our air transportation system is to our economy. I have a number of constituents in Colorado that are in the hospitality business and they always measure, Judge, how well we are doing in Colorado economically by how many people are getting on and off airplanes.

Chairman Hall mentioned the interagency Joint Planning and Development Office which was created in the 2003 *Vision 100—Century of Aviation Reauthorization Act,* and we asked the JPDO to tell us how we ought to develop the Next Generation Air Transportation System, NGATS. That is a big task. You all today are going to give us a sense of what we have accomplished as well as what lies ahead. And of course some of the most critical challenges involve issues related to transitioning from the current Air Traffic Management system to the proposed future NGATS concept, and that means new hardware and software, equipping fleets of aircraft, addressing a range of workforce and training issues, and then, of course, figuring out how to pay for it all.

It also appears, as Judge Hall mentioned, there is a significant R&D challenge to be met, if NGATS is to become a reality, and I am looking forward to hearing more about that R&D challenge from all of you here today on the panel. In particular, I want to better understand what is being done to identify the key research

needs and to align all of the agencies' research programs to those needs, and then, of course, to make sure that the research programs are relevant to the task ahead. That is R&D directly related to NGATS as well as R&D on such things as aircraft noise and emissions, and you all know that that will have an impact on community acceptance of increased airport operations.

Of course the willingness of agencies to commit the necessary budgetary resources to these R&D tasks will be another key determinant of our success or failure. And in that regard, I am concerned that NASA has planned to cut its commitment to NGATS R&D in half over the next five years, and I hope that the witnesses will help the Committee understand the likely impact of such a cut on JPDO's ability to meet these R&D challenges. And finally there is a question of whether or not the existing JPDO structure will be sufficient for all that lies ahead, or whether it would need to evolve into its own program office with its own budgetary authority.

Mr. Chairman, we clearly have a lot of issues to cover. I hope this will just be the first step in a continuing process of oversight of the JPDO and NGATS by the Committee NGATS is too important to the future—to the Nation's future well-being for us to do otherwise. And I am going to borrow a phrase from the Space Program. Failure is not an option, either in our Space Program or in the NGATS programs that we are proposing. So again, welcome and I look forward to your testimony.

[The prepared statement of Mr. Udall follows:]

PREPARED STATEMENT OF REPRESENTATIVE MARK UDALL

Good afternoon. I want to join the Chairman in welcoming our witnesses. Today's hearing is focused on something that should be of interest to all of us—the future of the Nation's air transportation system.

As Members of Congress, we all spend a lot of time on airplanes, and we have a vested interest in safe and efficient air travel.

In addition, of course, the Nation's air transportation system is a vital part of our economy, and we need to ensure that it can accommodate future anticipated demand.

As you know, this committee helped establish the intergency Joint Planning and Development Office (JPDO) in the 2003 *Vision 100—Century of Aviation Reauthorization Act.* We tasked JPDO with managing the development of the Next Generation Air Transportation System (NGATS). That's a formidable task.

Today's witnesses will give us an idea of what has been accomplished to date, as well as what challenges lie ahead. Of course, some of the most critical challenges involve issues related to transitioning from the current Air Traffic Management system to the proposed future NGATS concept.

And that means transitioning to new hardware and software, equipping fleets of aircraft, addressing a range of workforce and training issues, and figuring out how it will be paid for.

It also appears that there is a significant R&D challenge to be met if the NGATS is to become a reality. I'd like to hear more about that R&D challenge from our witnesses.

In particular, I want to better understand what is being done to identify the key research needs and align all of the agencies' research programs to those needs—and to ensure that those research programs are relevant to the task.

That includes R&D directly related to the NGATS as well as R&D on such things as aircraft noise and emissions—problems that will have a big impact on community acceptance of increased airport operations.

Of course, the willingness of agencies to commit the necessary budgetary resources to the R&D tasks will be another key determinant of the success or failure of the JPDO.

In that regard, I am concerned that NASA is planning to cut its commitment to NGATS R&D in half over the next five years. I hope that the witnesses will be able

to help this committee understand the likely impact of such a cut on the JPDO's ability to meet the R&D challenges facing the NGATS.

And finally, there is the question of whether or not the existing JPDO structure will be sufficient for all that lies ahead, or whether it will need to evolve into a Program Office with its own budgetary authority.

Well, Mr. Chairman, we have a lot of issues to consider. I hope that today's hearing will be just the first step in a continuing process of oversight of the JPDO and NGATS by this committee.

NGATS is too important to the Nation's future well-being for us to do otherwise. To borrow a phrase from the space program: "Failure is not an option" as far as NGATS is concerned. With that, I again want to welcome our witnesses, and I yield back the balance of my time.

[The prepared statement of Ms. Jackson Lee follows:]

PREPARED STATEMENT OF REPRESENTATIVE SHEILA JACKSON LEE

Le me first thank the Space and Aeronautics Subcommittee Chairman Calvert and Ranking Member Udall for holding this hearing today on a very important issue to my district of Houston, Texas. We are here today to examine how research and development (R&D) are progressing on the creation of a new air traffic control system that would be able to handle three times as much air traffic as the current system can. If our nation expects to stay on the cutting edge and lead the world's development of new technologies, it cannot afford to leave aeronautics research behind.

The Federal Aviation Administration (FAA) aerospace forecasts estimates that in 2005, U.S. carriers boarded 738.6 million passengers on domestic and international flights. By 2017, the number of passengers is forecast to be 1.07 billion, an increase of 45 percent. The number of aircraft handled by the FAA's air traffic control centers is predicted to be 47.2 million during 2006 and will grow to 67.7 million by 2017, a 43 percent increase.

Experts argue that today's system—with its reliance on ground radars, voice communications, and air traffic controllers directing each phase of flight—will not be able to accommodate this explosion in future demand. Because of Industry reliance on the hub-and-spoke system, congestion has evolved from an occasional nuisance into a national problem that faces travelers on an almost daily basis. Absent a fundamental change in the operation of the system, congestion will become more pervasive and, as a consequence, economic growth will become constrained.

The answer to our air traffic control congestion problems is said to be the Next Generation Air Transportation System (NGATS, pronounced "en-gatz"). This year FAA is providing $20 million and NASA is providing $18 million a year. To oversee that R&D, Congress in 2003, created the joint Planning and Development Office (JPDO) within the Federal Aviation Administration (FAA). JPDO was created to guide the activities of seven federal agencies, particularly the FAA and the National Aeronautics and Space Administration (NASA), as they design and implement a Next Generation Air Transportation System (NGATS).

These issues are so important to my constituency because, I am proud to say, Houston has two large airports at its disposal in the William P. Hobby Airport, and the Bush International Airport, and one civilian/military airport, Ellington Field. These facilities provide air travel for an estimated 39 million passengers each year. The long established William P. Hobby Airport served 8.86 million passengers in 1999, making it the 42nd busiest airport in the United States for passenger travel. While the Bush International Airport served 31 million passengers in 1998, making it the 13th busiest airport in the United States for total passengers and the 8th largest international passenger gateway in the Nation.

Ellington Field in Houston has the distinction of having the largest flying club in Texas and it's the site of the annual Wings Over Houston Airshow.

For people who live and work in the Houston area, the presence of these airports is vital to keeping the economic viability of the city strong. This makes the subject of increasing air traffic passenger capacity, while at the same time improving safety a top priority of mine.

I look forward to hearing from our panel of witnesses on how the development of a new, safe, and effective air traffic control system is proceeding. Thank you for the time to speak on this important issue Mr. Chairman; I yield the remainder of my time.

Mr. HALL. All right. Mr. Ehlers has just stepped out to take a phone call. I was going to recognize him for an opening statement, but we will let him make it whenever he wants to in between your

opening statements. Each of you will have five minutes. We are not going to put the watch on you or anything like that, stopwatch or anything. We neither urge you to stop right at five minutes. We don't urge you even to use your full five minutes, unless you think you need it, and if you go over a little, that will be all right, because we thank you for being here. And at this time I will recognize Mr. Shane for five minutes. You can review and take it and use it any way you want to use it. Mr. Shane, thank you, sir. Turn your mike on, please.

STATEMENT OF THE HON. JEFFREY N. SHANE, UNDER SECRETARY OF TRANSPORTATION FOR POLICY, U.S. DEPARTMENT OF TRANSPORTATION

Mr. SHANE. Forgive me. Thank you again, Congressman Hall and Congressman Udall, for those kind remarks for all of us. We are delighted that you are having this hearing today and very pleased to be able to talk to you about the JPDO and NGATS itself. I want to thank you for the opportunity to testify today on behalf of the JPDO and its vital role in fostering the establishment of the Next Generation Air Transportation System. The development of NGATS is a very high priority for Secretary Norm Mineta, for FAA Administration Marion Blakey, and for all of us at the Department of Transportation and the other participating agencies, and I have very pleased to be here with you today as DOT's representative.

The NGATS initiative is unprecedented in its scope and in its complexity and in the challenges that it is going to face. Our vision of this system is one that encompasses the whole air travel experience from the moment the passenger arrives at the departure airport to his or her exit from the destination airport. NGATS addresses the security, safety and efficiency of passenger and cargo air transportation. Aircraft will be able to partake of information technology in a more robust way, with enhanced capabilities in the cockpit, better navigation and landing capabilities, and a far more comprehensive and accurate knowledge of weather and traffic conditions in real time. And users of the system, who will be flying in a far more diverse array of aircraft types than we have today, will experience less delay in the current system—than in the current system, and with a less intrusive security process, with increased safety and all the while, while the system is handling up to three times the traffic as the current system handles.

We have a great air traffic control system today, but NGATS will be more flexible and resilient, more scalable, more adaptive and more highly automated than today's system. The NGATS operational vision is not just related to the air traffic system alone, but also includes the preservation and growth of airports, of heliports, and other future landing and departure facilities to fully incorporate the emerging NGATS' benefits. This system will be built in a far more robust information network than anything we have seen to date, ensuring that the right information gets to the right person at the right time, while keeping the Nation safe and the traffic flowing smoothly. You will increasingly cut the cord between ground and air as we put more information directly into the cockpit of intelligent aircraft through sensors and satellites linked together through network communications.

Under the leadership of FAA Administrator Blakey, the JPDO now serves as a focal point for coordinating the research related to air transportation for agencies across the entire Federal Government, including the Departments of Transportation, Commerce, Defense, and Homeland Security, as well as NASA. It was clear from the outset that an initiative of this magnitude and this complexity could never be completed successfully by DOT alone, particularly in a post-9/11 world. We sought support from others and they delivered. NASA has been particularly close as a partner from the beginning, and all the other agencies involved have provided invaluable support to the JPDO and have helped us establish a strong and collaborative atmosphere.

Another special feature of this initiative is the high-level participation we enjoy from each of these organizations. Secretary Mineta chairs a senior policy committee made up of deputy secretary-level officials from the other departments, as well as from the President's Office of Science and Technology Policy. The senior policy committee directs the effort and will be responsible for its ultimate success of failure. The participating agencies have been enthusiastically engaged from the outset and we are grateful for their continued support.

I have to emphasize that not all elements of the system, of NGATS, as it will look in 2025 are known today. Research will continue to help us find the right balance between the centralized ground-based system that we have today and the totally distributed system we envision for tomorrow, where aircraft largely self-manage their flight with full knowledge of their environment. That research is being undertaken through a close partnership with industry and with other stakeholders. The process ensures full coordination of research across agency lines and between government and the private sector in ways that have not been done in the past. We are already spending significant resources each year on air transportation-related research. By better coordinating our actions, avoiding duplication and tying these activities together through a long-term integrated national plan, we can maximize the benefits of those public and private investments and target our resources more effectively.

We need the best minds in America, from both the public and private sectors, working on the task of creating a next generation system. To achieve this we have established the NGATS Institute to allow stakeholders to get directly involved in the transformation process. And while the Aerospace Industries Association is the host for the institute, it is co-chaired by the presidents of the Airline Pilots Association and the Air Transport Association, and open for participation by all segments of the industry.

The JPDO achieved important milestones in 2005 towards building the NGATS system. The JPDO completed its internal organization and created eight government/industry integrated product teams, IPTs, to break this large and complex project into manageable strategies. These strategies focus on those aspects of aviation that hold the keys to capacity and efficiency improvements, airport infrastructure, security, a more agile air traffic system, shared situational awareness, safety, environmental concerns, weather, and global harmonization of equipage and operations. Each agency in-

volved in the initiative leads at least one of the IPTs. The teams work closely with our stakeholders to ensure that they have an early window into our thinking and that we take full advantage of their expertise at every step of the way.

The IPTs have already begun the important process of moving from the general to the specific, and from objectives to capabilities. As of December 2005, nearly 200 industry and private sector participants representing about 70 organizations and companies were actively involved in the ITP—IPTs planning and development work. This participation has been a major initial focus of the NGATS Institute. The NGATS concepts of use and operations and its enterprise architecture will be released for comment this summer. In 2005, the JPDO moved ahead with plans to accelerate the development of key next generation systems projects, such as Automatic Dependent Surveillance Broadcast, ADS–B, System Wide Information Management, or SWIM as we call it, and in fiscal year 2007 and in the President's budget proposal, the Administration proposed several targeted investment areas to promote early implementation of elements of the next generation system. These accomplishments are all highlighted in the recently published 2005 Progress Report to the NGATS Integrated Plan that was transmitted to Congress on March the 10th as required by *Vision 100,* the last aviation reauthorization act.

Another major change in support of NGATS is the restructuring of the NASA Aeronautics Program. Under the leadership of Administrator Michael Griffin and my colleague on this panel, Associate Administrator Lisa Porter, the program has been restructured with one of its three tenets being to support the development of NGATS. In fact, one of its major four elements, the Airspace Systems Program, is completely dedicated to the air traffic management requirements of NGATS.

Congressman Hall and other Members of this subcommittee, NGATS will require years of hard work and unparalleled coordination among the many federal agencies and stakeholders involved. The process has now begun in earnest, however, and by aligning our resources and activities through the JPDO, we are all confident that we will succeed. We will, of course, need strong support from Members of Congress, and therefore we look forward to working with all of you as this critical endeavor proceeds. That concludes my testimony and of course I will be very happy to answer questions at the appropriate time.

[The prepared statement of Mr. Shane follows:]

PREPARED STATEMENT OF JEFFREY N. SHANE

Good afternoon, Chairman Calvert, Congressman Udall, and Members of the Subcommittee. I would like to thank you for the opportunity to testify today on such an important subject as the Joint Planning and Development Office, or JPDO, and its vital role in fostering the establishment of the Next Generation Air Transportation System. The development of the Next Generation Air Transportation System, or NGATS, is a high priority for Secretary Mineta, Administrator Blakey, and all of us at the Department of Transportation. I am very pleased to be with you today as the Department's representative.

The NGATS initiative is unprecedented in its scope, complexity and the challenges it will face. Our vision of this system is one that encompasses the whole air travel experience—from the moment the passenger arrives at the departure airport to his or her exit from the destination airport. The NGATS System includes security, safety, and efficiency of passenger, cargo and aircraft operations. Aircraft will

be able to use information technology in a more robust way, with enhanced capabilities in the cockpit, better navigation and landing capabilities, and far more comprehensive and accurate knowledge of weather and traffic conditions in real time. And, the users of the system, who will be flying in a far more diverse array of aircraft types, will find the system works with less delay than the current system, with a less intrusive security process, and with increased safety, all while handling significantly increased traffic as compared to the current system.

We have a great air traffic control system today. But the Next Generation Air Transportation System will be more flexible, resilient, scalable, adaptive, and highly automated than today's system. The NGATS operational vision is not just related to the air traffic management system alone, but also includes the preservation and growth of airports, heliports, and other future landing and departure facilities to fully incorporate the emerging NGATS benefits. This system will be built on a far more robust information network than anything we have seen to date, ensuring that the right information gets to the right person at the right time, while keeping the Nation safe and the flow of traffic running smoothly. We will increasingly cut the cord between ground and air as we put more information directly into the cockpit of intelligent aircraft through sensors and satellites linked together through network communications.

The importance of developing this system of the future is also quite clear to policy-makers in Europe, where a comparable effort is well underway. This presents both a challenge and an opportunity to the United States. Creating a modernized, global system that provides inter-operability could serve as a tremendous boost to the aerospace industry, fueling new efficiencies and consumer benefits. Alternatively, we could also see a patchwork of duplicative systems and technologies develop, which would place additional cost burdens on an industry already struggling to make ends meet.

Under the leadership of FAA Administrator Blakey, the JPDO now serves as a focal point for coordinating the research related to air transportation for agencies across the Federal Government, including the Departments of Transportation, Commerce, Defense and Homeland Security, as well as NASA. Early on, we realized that an initiative of this magnitude and complexity could never be successfully completed by DOT alone, especially in a post-9/11 world. We sought support from others, and they delivered. NASA has been a close partner from the beginning, and all the other agencies involved have provided invaluable support to the JPDO that has helped us establish a strong, collaborative atmosphere.

Another special feature of this initiative is the high-level participation from each of these organizations. Secretary Mineta chairs a Senior Policy Committee made up of Deputy Secretary-level officials from the other organizations, and the White House Office of Science and Technology Policy (OSTP). The Senior Policy Committee directs the effort and will be responsible for its ultimate success or failure. The participating agencies have been highly engaged from the outset, and we are grateful for their continued support.

Our overarching goal in the NGATS System initiative is to develop a system that will be flexible enough to accommodate a wide range of users—very light jets and large commercial aircraft, manned and unmanned air vehicles, small airports and large, business and vacation travelers alike, while handling a significantly increased number of operations with no diminution in safety, security and efficiency. I must emphasize that not all elements of the NGATS system in 2025 are known today. Research will continue to help us find the right balance between a centralized ground system and a totally distributed system, where aircraft "self-manage" their flight with full knowledge of their environment.

That research is being undertaken through a close partnership with the research community, industry and other stakeholders. This process ensures full coordination of research across agency lines and between government and the private sector in ways that have not been done in the past. The fact is that we already have a sizable amount of resources being spent each year on air transportation-related research. By better coordinating our actions, avoiding duplication and tying these activities together through a long-term, integrated national plan, we can maximize the benefits of those public and private investments and target our limited resources more effectively.

Existing Federal Advisory Committees will be used to ensure all plans and decisions receive broad review and public comment. These committees include senior-level executives from across industry empowered to provide advice on strategy and transition issues.

We need the best minds in America across both the public and private sectors working on the task of creating a NGATS system. To achieve this, we have established a Next Generation Air Transportation System Institute (the NGATS Insti-

tute) that allows stakeholders to get directly involved in the transformation process. And, while the Aerospace Industries Association (AIA) is the host for the Institute, it is co-chaired by the presidents of the Air Line Pilots Association and the Air Transport Association and open for participation by all segments of the industry.

The Joint Planning and Development Office (JPDO) achieved important milestones in 2005 towards building the NGATS system. The JPDO completed its internal organization and created eight government/industry Integrated Product Teams (IPTs) to break this large and complex project into manageable strategies. These strategies focus on those aspects of aviation that hold the keys to capacity and efficiency improvements—airport infrastructure, security, a more agile air traffic system, shared situational awareness, safety, environmental concerns, weather and global harmonization of equipage and operations. Each agency involved in the initiative leads at least one of the Integrated Product Teams. The Teams work closely with our stakeholders to ensure that they have an early window into our thinking and that we take full advantage of their expertise every step of the way. What truly sets this new structure apart is that it eliminates duplication of effort and gets everyone involved in aviation across the Federal Government working toward a common goal—creation of a NGATS system.

The IPTs have already begun the important process of moving from the general to the specific, and from objectives to capabilities. As of December 2005, nearly 200 industry and private sector participants representing around 70 organizations and companies were actively involved in the IPTs' planning and development work. This participation has been a major initial focus of the NGATS Institute. The NGATS Concepts of Use and Operations, and a preliminary Enterprise Architecture will be released for comment this summer. In 2005, the JPDO moved ahead with plans to accelerate the development of key NGATS projects, such as Automatic Dependent Surveillance–Broadcast (ADS–B), and System Wide Information Management (SWIM). In its Fiscal Year 2007 budget proposal, the Administration proposed several targeted investment areas, to promote early implementation of elements of the NGATS system. The details of these programs will evolve over time as the Enterprise Architecture is fully developed and system requirements are established. These accomplishments are highlighted in the recently published "2005 Progress Report to the NGATS Integrated Plan" that was transmitted to Congress on March 10th as required by *Vision 100*.

One of these very promising initiatives, with potential for broad operational applications, is the Automatic Dependent Surveillance–Broadcast (ADS–B) system, a technology that will replace ground-based radar systems and revolutionize air navigation and surveillance. For FY 2007, the President's budget includes $80 million for the FAA for the ADS–B program. The ADS–B system was the key enabling technology for the Capstone demonstration program in the Alaska Region.

Capstone is a technology-focused safety program in Alaska that seeks near-term safety and efficiency gains in aviation by accelerating implementation and use of modern technology, in both avionics and ground system infrastructure. The impetus for the Capstone program was a series of meetings between the FAA and aviation interests to address the exceedingly high accident rate in Alaska for small aircraft operations, which was nearly five times greater than the national average. Through 2005, the Capstone Program achieved significant safety and efficiency results. Capstone-equipped aircraft have had a consistently lower accident rate than non-equipped aircraft. From 2000 through 2005, the rate of accidents for Capstone-equipped aircraft dropped significantly—by 49 percent. That is real progress.

Another technological innovation, known as Required Navigation Performance, or RNP, adds capacity, improves efficiency and reduces fuel consumption. RNP uses on-board technology that allows pilots to fly more direct point-to-point routes reliably and accurately. RNP is extremely accurate, and gives pilots not only lateral guidance, but vertical precision as well. RNP reaches all aspects of the flight—departure, en route, arrival, and approach. For example, in January 2005, in partnership with Alaska Airlines, we implemented new RNP approach procedures at Palm Springs International Airport, which is located in very mountainous terrain. Under the previous conventional procedures in use at Palm Springs, planes could not land unless the ceiling and visibility were at least 2,300 feet and three miles. With these new RNP procedures, approved air carriers can now operate with a ceiling and visibility as low as 734 feet and one mile. This lower landing minima has allowed Alaska Airlines to "save" 27 flights between January and November, 2005, flights which would have otherwise had to divert to Ontario, California—an added distance of at least 70 miles.

Given its fundamental importance to the success of the NGATS System, establishing an initial Network-Enabled Operations (NEO) capability is a high priority. Current efforts focus on identifying the network architecture and enacting stand-

ards for information and safety data sharing. This is the situation today: DOD has already invested considerable resources in information technology and telecommunication research focused on NEO and information access and sharing. FAA, DHS and Commerce are also committed to developing network-centric information architectures. The opportunity now exists to synchronize these efforts, especially in the areas of data inter-operability and compatible network-to-network interface mechanisms. Two on-going DOD initiatives—the synchronization of DOD and DHS classified networks and DOD's development of its Net-Centric Enterprise Services—will serve as templates for this effort.

In 2005, the JPDO, FAA and an industry team demonstrated how network-enabled concepts developed for the military customers can be applied to Air Traffic Management. The Joint Network-Enabled Operations Security Demonstration connected seven Air Traffic Management and security systems distributed over 12 different locations. It showed how sharing information in real time across air traffic, air defense, and law enforcement domains helps agencies respond to a security incident more efficiently. The exciting part of the NEO demonstration project is that it enabled communication between agencies' individual, stove-piped networks, eliminating the need to throw out all the individual legacy systems and create a brand new mega-system, which would be prohibitively expensive.

In July 2006, the JPDO will also conduct a demonstration project involving the FAA's System Wide Information Management (SWIM) program—the beginning of network-centric operation in the National Airspace System. The President's budget proposal for Fiscal Year 2007 requests $24 million for FAA's SWIM program.

Another major change in support of NGATS is the restructuring of the NASA Aeronautics Program. Under the leadership of Administrator Griffin and Associate Administrator Porter, the program has been restructured with one of its three tenets being to support the development of NGATS. In fact, one of its four major elements—the Airspace Systems Program, is completely dedicated to the air traffic management requirements of NGATS. The program will be pioneering automated, high density, trajectory management technologies to completely change the way traffic is managed and controlled in the future. Automated trajectory management is at the heart of the NGATS operational concept. NASA has been working in this area of research for years, with notable successes, like the Traffic Management Advisor, which provides time-based metering of aircraft flows. The Traffic Management Advisor is in operation today and is in the process of being deployed throughout the National Airspace System.

Mr. Chairman, NGATS will require years of hard work and unparalleled coordination among the many federal agencies and stakeholders involved. The process has now begun in earnest, however, and by aligning our resources and activities through the JPDO, I am confident we will succeed. We will, of course, need strong support from Members of Congress, and we therefore look forward to working with all of you on this critical endeavor.

This concludes my testimony. Thank you very much for the opportunity to appear before you today, and I look forward to answering your questions.

BIOGRAPHY FOR JEFFREY N. SHANE

Jeffrey N. Shane was appointed by President Bush as Under Secretary of Transportation for Policy in March 2003 following his confirmation by the United States Senate. In this position, he serves as principal policy advisor to the Secretary of Transportation, with oversight responsibility for the Office of Transportation Policy and the Office of Aviation and International Affairs. President Bush earlier appointed Mr. Shane as Associate Deputy Secretary of Transportation, a position in which he served for a year prior to his current appointment.

Before returning to public service, Mr. Shane was a partner at the international law firm of Hogan & Hartson L.L.P. in its Washington, DC, office. He had a domestic and international transportation practice, with a major emphasis on regulatory, legislative, and transactional issues.

Prior to entering the private practice of law Mr. Shane held a number of other positions in transportation policy in the Federal Government. At DOT he served as Assistant Secretary for Policy and International Affairs (1989–1993), Deputy Assistant Secretary for Policy and International Affairs (1983–1985), and Assistant General Counsel for International Law. He also served as Deputy Assistant Secretary of State for Transportation Affairs (1985–1989).

From 1994 through 2001 Mr. Shane was Chairman of the Commission on Air Transport of the International Chamber of Commerce and Chairman of the Military Airlift Committee of the National Defense Transportation Association. He was Chair of the American Bar Association's Forum on Air and Space Law from 2001 to early

2002. From 1985 through 1989, he was Adjunct Professor of Law at Georgetown University, teaching a course in International Transportation Law.

Mr. Shane received his undergraduate degree from Princeton University and his law degree from Columbia University, where he was Articles Editor of the *Columbia Journal of Law and Social Problems.* He is a member of the District of Columbia Bar.

Mr. Shane and his wife, Jean Wu, live in Washington, DC.

Mr. HALL. Thank you very much, Mr. Shane, and express to our former colleague, Mr. Mineta, our appreciation for your appearing here.

Mr. SHANE. Thank you. I will.

Mr. HALL. The Chair, at this time, recognizes Dr. Lisa Porter, Associate Administrator for Aeronautics of NASA. Dr. Porter, you have the right to read your statement, give your statement, give a summary of your statement, and we recognize you at this time for your statement.

STATEMENT OF DR. LISA J. PORTER, ASSOCIATE ADMINISTRATOR FOR AERONAUTICS, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

Dr. PORTER. Thank you, Congressman Hall, and thank you, Congressman Udall, for this opportunity to appear before you today to discuss the status of the Next Generation Air Transportation System, or NGATS. NASA is committed to working with our partners at the JPDO to provide the high-quality research and technical excellence required to develop the NGATS. NASA's Aeronautics Research Mission Directorate is currently undergoing a comprehensive restructuring to ensure that we have a strategic plan in place that enables us to pursue long-term cutting-edge research for the benefit of the broad aeronautics community. One of the key principles of our reshaping efforts is to directly address the fundamental research needs of the NGATS while working closely with our agency partners in the JPDO.

The future air traffic management system must be scalable to support increased capacity, as well as flexible to accommodate the wide variety of air vehicles that will be flying within the system. New concepts and technologies must be conceived and developed that will completely transform the overarching structure that will coordinate thousands of vehicles operating in a national airspace at any given time. NASA's Airspace Systems Program will therefore focus on developing revolutionary concepts, technologies and capabilities that will enable significant increases in the capacity, efficiency and flexibility of our national airspace system.

However, it is critical to recognize that the challenges we face in developing the future air transportation system are not limited to air traffic management alone. Future air vehicles will need to address substantial noise, emissions, efficiency and performance challenges. These are issues that cannot be worked in isolation. A holistic approach to vehicle design will be required in order to address multiple and often conflicting design requirements. Therefore, a key a focus of NASA's Fundamental Aeronautics Program will be the development of physics-based predictive design tools that will enable the rapid evaluation of new concepts and technologies and that will accelerate their application into a wide variety of future air vehicles. This capability will only be possible if we

are dedicated to the pursuit of knowledge across all the aeronautics disciplines that are critical in the design of air vehicles.

Furthermore, as we look toward the future, at the projected increases in air traffic and future system capabilities, we must make a firm commitment to conduct the research necessary to ensure that our high safety standards are not compromised. NASA's Aviation Safety Program will therefore focus on developing cutting-edge tools, methods and technologies intended to improve the intrinsic safety attributes of aircraft that will be operating in the evolving NGATS.

In short, NASA's Aeronautics Directorate has constructed a balanced research portfolio that draws upon our NASA-unique capabilities to address air traffic management, vehicle design and safety-related challenges, all of which must be worked in order for the NGATS vision to be realized. NASA has interacted closely with the JPDO during the past several months to ensure proper alignment of our research plans with the needs of the NGATS. Our researchers are the NASA centers are currently developing detailed technical proposals that will include integrated, multi-year research plans with milestones that are challenging but also technically sound. These proposals will undergo a rigorous review by several government experts, including members of the JPDO, to ensure that the plans are technically credible and well aligned with the NGATS vision. This level of coordination and cooperation will remain an ongoing element of NASA's strategic partnership with the JPDO.

Finally, in addition to conducting research that directly addresses the challenges of the NGATS, we have placed a strong emphasis on active participation in the JPDO, providing personnel, analysis tools, and funds to directly support JPDO functions and activities. NASA is actively involved in all of the organizational elements of the JPDO, from the integrated product teams and the evaluation and analysis division up through the senior policy committee.

Now, obviously, a vision as revolutionary and ambitious as that of the NGATS will face some significant challenges in the coming months and years. Programmatically, the most obvious challenge is preserving the strong cooperation that currently exists among the member agencies over the next two decades. It is imperative that the JPDO remain focused on close cooperation at all levels. Currently, this is accomplished at the technical level through the integrated product teams and the joint architecture council. From an oversight perspective, a senior interagency board is in place to support the senior policy committee and ensure that a high-level leadership is engaged in all critical aspects of the NGATS development. All member agencies of the JPDO must remain committed to supporting these processes, and the processes themselves must continue to evolve as the NGATS development matures.

Technically, the most important near-term challenge is the development of the enterprise architecture. This step is necessary to establish the system-level requirements that are clear, verifiable and attainable. While the capabilities articulated in the JPDO's NGATS vision have enabled each agency to vector its research portfolio in the right direction, the establishment of detailed system requirements will allow each member agency to better refine its R&D

plans. Given that every agency has budget constraints and always will, the establishment of an enterprise architecture will be critical to ensure that each agency can prioritize its R&D investments in the manner that provides the maximum return on investment. The JPDO intends to provide a preliminary enterprise architecture by the summer of 2006.

Once again, thank you for this opportunity to testify today and I would be happy to answer any questions that you may have.

[The prepared statement of Dr. Porter follows:]

PREPARED STATEMENT OF LISA J. PORTER

Mr. Chairman and Members of the Subcommittee, thank you for this opportunity to appear before you today to discuss the status of the Next Generation Air Transportation System (NGATS). NASA is committed to working with our partners at the Joint Planning and Development Office (JPDO) to provide the high-quality research and technical excellence required to develop the NGATS.

NASA's Aeronautics Research Mission Directorate (ARMD) is currently undergoing a comprehensive restructuring to ensure that we have a strategic plan in place that enables us to pursue long-term, cutting-edge research for the benefit of the broad aeronautics community. The three principles guiding this restructuring are as follows: 1) we will dedicate ourselves to the mastery and intellectual stewardship of the core competencies of aeronautics in all flight regimes; 2) we will focus our research in areas appropriate to NASA's unique capabilities; and 3) we will directly address the fundamental research needs of the NGATS while working closely with our agency partners in the JPDO.

Regarding the third principle, one of the research challenges that NASA will directly address will be that of Air Traffic Management (ATM). While our current ATM system has served the country well, there are critical shortcomings that prevent it from meeting anticipated future demands. The future ATM system must be scalable to support increased capacity as well as flexible to accommodate the wide variety of air vehicles that will fly within the system. New concepts and technologies must be conceived and developed that will completely transform the overarching structure that will coordinate thousands of vehicles operating in the national airspace at any given time.

However, it is important to recognize that the challenges we face in developing the NGATS are not limited to ATM alone. For our air transportation system to continue to function, future air vehicles will need to address substantial noise, emissions, efficiency, and performance challenges. These are issues that cannot be worked in isolation—a holistic approach to vehicle design will be required in order to address multiple and often conflicting design requirements. Furthermore, as both the vehicles and the airspace system become increasingly complex, we must make a commitment to conduct the research necessary to ensure that our high safety standards are not compromised.

Therefore, NASA's ARMD will conduct the long-term, cutting edge research that will be necessary to ensure revolutionary capabilities for both the air vehicles of the future as well as the air transportation system in which they will fly. Gone are the days when one can design innovative vehicles without consideration of the airspace, and the converse is, of course, equally true. We have four major programs—the Airspace Systems Program, the Aviation Safety Program, the Fundamental Aeronautics Program, and the Aeronautics Test Program—each of which contributes to the research needs of the future air transportation system, as described in more detail below. NASA has constructed a balanced research portfolio that draws upon our NASA-unique capabilities to address ATM, vehicle, and safety-related research challenges, all of which must be worked in order for the NGATS vision to be realized. Budget allocations across the programs are based upon the long-term research needs and goals of each program as well as the capabilities currently available at each of the research centers. Funding levels among the programs have been balanced to ensure that our intellectual stewardship of the core competencies of aeronautics is not compromised.

ARMD has interacted closely with the JPDO during the past several months to ensure proper alignment of our research plans with the needs of the NGATS. Specifically, members of the JPDO provided feedback regarding the content of our preliminary research plans in all of our programs before we presented them publicly at an American Institute of Aeronautics and Astronautics conference in January 2006. Our researchers at the NASA centers are currently developing detailed tech-

nical proposals that build upon that preliminary work. The proposals will include integrated multi-year research plans, with milestones that are challenging but also technically sound. These proposals will undergo a rigorous review by several government experts, including members of the JPDO, to ensure that the plans are technically credible and well-aligned with the NGATS vision. This level of coordination and cooperation will remain an ongoing element of the ARMD strategic partnership with the JPDO.

Finally, in addition to conducting research that directly addresses the challenges of the NGATS, we have placed a strong emphasis on active participation in the JPDO itself, providing personnel, analysis tools, and funds to directly support JPDO functions and activities. NASA is actively involved in all the organizational elements of the JPDO, from the Integrated Product Teams (IPTs) and the Evaluation and Analysis Division (EAD) up through the Senior Policy Committee (SPC), which oversees the work of the JPDO and is chaired by the Secretary of Transportation.

Airspace Systems

The objective of the Airspace Systems Program (ASP) is to develop revolutionary concepts, capabilities, and technologies that will enable significant increases in the capacity, efficiency and flexibility of our National Airspace System (NAS)—an objective that is clearly aligned with the JPDO's vision of the NGATS. The ASP consists of two projects: the NGATS ATM: Airspace Project and NGATS ATM: Airportal Project.

The NGATS ATM: Airspace Project will develop and explore fundamental concepts and integrated solutions that address the optimal allocation of ground and air automation technologies necessary for the NGATS. The project will focus NASA's technical expertise and world-class facilities to address the question of where, when, how, and the extent to which automation can be applied to moving aircraft safely and efficiently through the NAS. Research in this project will address Four-Dimensional (4D) Trajectory Operations including advances in the science and applications of multi-aircraft trajectory optimization that solves the demand/capacity imbalance problem while taking into account weather information and forecast uncertainties and keeping aircraft safely separated. Our research will develop and test concepts for advanced Traffic Flow Management to provide trajectory planning and execution across the spectrum of time horizons from "strategic planning" to "separation assurance." We will also conduct research to explore Dynamic Airspace Configuration that addresses the technical challenges of migrating from the current structured, static homogeneous airspace to a dynamic, heterogeneous airspace that adapts to user demand and meets changing constraints of weather, traffic congestion, and a highly diverse aircraft fleet. Ultimately, the roles and responsibilities of humans and automation touch every technical area and will be addressed thoroughly.

Working in close collaboration with the NGATS ATM: Airspace Project, the NGATS ATM: Airportal Project will develop and validate algorithms, concepts, and technologies to increase throughput of the runway complex and achieve high efficiency in the use of airportal resources such as gates, taxiways, runways, and final approach airspace. Currently, the growth of air traffic demand and fleet diversity is causing the operational volume at hub airports to rapidly approach their maximum capacity. NASA research in this project will lead to development of solutions that safely integrate surface and terminal area air traffic optimization tools and systems with 4D trajectory operations. To support super-density and equivalent visual operations, NASA will also conduct research in wake hazard sensing and prediction.

Substantial leveraging of research across the two projects will occur in areas such as computational science and engineering, applied mathematics for system optimization, trajectory design and conformance, automation design, and adaptive air/ground automation. Ultimately, the results of the two projects will be integrated to ensure gate-to-gate solutions that are aligned with the NGATS needs.

Aviation Safety

Through the vigilance of industry and government, the U.S. Air Transportation System is widely recognized as one of the safest transportation systems worldwide. Looking toward the future at the projected increases in air traffic and future system capabilities, this vigilance must continue in order for the U.S. to meet both the public expectations for safety and the full realization of the NGATS. To help meet these future challenges, the Aviation Safety Program (AvSP) will focus on developing cutting-edge technologies intended to improve the intrinsic safety attributes of aircraft that will be operating in the evolving NGATS. The four projects in the AvSP are as follows: Integrated Vehicle Health Management (IVHM), Aircraft Aging and Durability (AAD), Integrated Intelligent Flight Deck (IIFD), and Integrated Resilient Aircraft Control (IRAC).

The focus of the IVHM and the AAD projects are to improve the inherent resiliency, life-cycle durability, and maintenance of modern aircraft and associated on-board systems. The IVHM project will conduct research to advance the state of highly integrated and complex flight critical health management technologies and systems. Potential benefits include reduced occurrence of in-flight system and component failures, and on-board systems capable of self-detecting and self-correcting anomalies during a flight that could otherwise go unattended until a critical failure occurs. The AAD project will develop advanced diagnostic and prognostic capabilities for detection and mitigation of aging-related hazards. The research and technologies to be pursued will decrease the susceptibility of current and next generation aircraft and on-board systems to pre-mature deterioration and failures, thus greatly improving vehicle safety and mission success.

New capabilities envisioned for the NGATS such as Super Density Operations, Aircraft Trajectory-Based Operations, and Equivalent Visual Operations pose potential safety challenges for ensuring optimum crew workload distribution and application of advanced flight critical automatic and autonomous systems. The AvSP will conduct research on advanced vehicle-based capabilities to address potential unintended consequences that could compromise vehicle or system safety. The IIFD project will pursue flight deck related technologies that will ensure that crew workload and situation awareness are both safely optimized and adapted to the NGATS future operational environment. The IRAC project will conduct research to advance the state of aircraft flight control automation and autonomy in order to prevent loss-of-control in flight, which is the accident category that currently has the highest number of aircraft accidents. Taking into account the advanced automation and autonomy capabilities as envisioned by NGATS, the research will pursue methodologies to enable an aircraft to automatically detect, avoid, and/or safely recover from an unusual attitude or adverse condition.

Fundamental Aeronautics

The Fundamental Aeronautics Program (FA) is dedicated to the mastery and intellectual stewardship of the core competencies of aeronautics across all flight regimes. Researchers in FA will conduct cutting-edge research across multiple disciplines including aerothermodynamics, acoustics, propulsion, materials and structures, computational fluid dynamics, and experimental measurement techniques. The focus of this research is the generation of pre-competitive high-fidelity data and design tools that will be applicable across all flight regimes including subsonics (both fixed and rotary wing), supersonics, and hypersonics.

Future aircraft in the NGATS will need to be quiet and clean to meet stringent noise and emissions regulations. Additionally, these air vehicles will need to meet challenging performance requirements to make them economically viable alternatives to the existing fleet. A holistic approach to vehicle design will therefore be required in order to address multiple and often conflicting design requirements. This in turn requires substantial improvements in our current ability to predictively design aircraft.

Today's design tools can be used for incremental improvements to existing engines and airframes. However, because they are based on empirical knowledge obtained over a long history of small design improvements, they cannot be used to design radically new engines and air vehicles. A key focus of FA will be the development of physics-based Multi-disciplinary Analysis and Optimization (MDAO) tools that will enable the rapid evaluation of new concepts and technologies. These tools will accelerate the application of new technology to a wide array of air vehicles. This revolutionary approach will only be possible if we make a firm commitment to the pursuit of knowledge across all of the aeronautics disciplines that are critical in the design of air vehicles.

We must acknowledge that the challenges of the future are so substantial that we must not falter in our commitment to a long-term investment in cutting-edge research. We must conduct high quality research to address fundamental scientific and engineering issues in such areas as noise source characterization, combustion chemistry, alternative fuel chemistry, turbulence modeling, materials design, and active flow control. Only by taking a strategic and comprehensive approach to air vehicle research will we be able to assure the future of air transportation in this country.

Aeronautics Test Program

NASA has established the Shared Capability Asset Program (SCAP), which includes the Aeronautics Test Program (ATP). The ATP ensures the long-term availability and viability of the set of aeronautics test facilities that NASA, working with the Department of Defense (DOD) and the U.S. aircraft industry, considers to be

of national strategic importance. Several of these facilities will be critical in supporting research that directly addresses the research needs of the NGATS. These include ground test facilities that are used to simulate adverse weather conditions, to measure engine and airframe noise, and to measure engine emissions.

Evaluation and Analysis

In addition to conducting research that directly addresses the challenges of the NGATS, NASA provides a direct role in evaluating and analyzing proposed systems-level NGATS concepts and architectures. NASA personnel are key members of the JPDO Evaluation and Analysis Division (EAD), which is now an inherent entity within the JPDO. Many of the sophisticated simulations and models being used by the EAD to evaluate concepts to ensure that we will be developing a system that will most efficiently and effectively meet the needs of tomorrow's air transportation system have been developed by NASA. Likewise, NASA employs these tools to evaluate the impacts of its own research program upon the national objectives for transformation.

Challenges for the JPDO and the Way Ahead

The JPDO's vision for the NGATS is revolutionary and ambitious and therefore faces some significant challenges. Programmatically, the most obvious challenge is that of preserving the strong cooperation that currently exists among the member agencies for the next twenty years. Such cooperation is often personality-driven, but it must be sustained as individuals in each organization come and go. It is therefore imperative that the JPDO remains focused on close cooperation at all levels. Currently, this is accomplished at the technical level through the multi-agency IPTs and the joint architecture council. From an oversight perspective, a senior interagency board is in place to support the SPC and ensure that high-level leadership is engaged in all critical aspects of the NGATS development. All member agencies of the JPDO must remain committed to supporting these processes, and the processes themselves must continue to evolve as the NGATS development matures.

A perhaps less obvious but equally important challenge is the necessity to not compromise technical integrity as the JPDO faces the reality of maintaining "advocacy" among stakeholders. In other words, the JPDO must be willing to adjust technical goals and milestones if research results determine that it is necessary to do so. The JPDO cannot succumb to political pressures of overselling or overstating system-level goals that are found to be technically or economically infeasible. A commitment to technical integrity will be critical to the long-term success of the JPDO.

Technically, the most important near-term challenge is the development of the Concept of Operations and the Enterprise Architecture. This step is necessary to establish system-level requirements that are clear, verifiable, and attainable. While the capabilities articulated in the JPDO's NGATS vision have enabled each agency to vector its research portfolio in the right direction, the establishment of detailed system requirements will allow each member agency to better refine its R&D plans. Given that every agency has budget constraints, and always will, the establishment of an Enterprise Architecture will be critical to ensure that each agency prioritizes its R&D investments in the manner that provides the maximum return on investment for the JPDO. The JPDO intends to provide a preliminary Enterprise Architecture by the summer of 2006.

One of the significant "mid-to-long-term" technical challenges will be the implementation of automation platforms for strategic 4D trajectory management and tactical separation assurance. While NASA will need to provide sustained and focused research in these areas, ultimately it will be the JPDO that must manage the transfer of the technology to the FAA for system development and implementation.

Conclusion

In conclusion, NASA's ARMD is investing in long-term, cutting-edge research in areas that are appropriate to NASA's unique capabilities in order to enable the NGATS vision. We have aligned our research portfolio to meet this challenge with an efficient allocation of resources and an unwavering commitment to technical excellence.

BIOGRAPHY FOR LISA J. PORTER

Lisa J. Porter, the Associate Administrator for the Aeronautics Research Mission Directorate, leads the Agency's aeronautics research efforts and is co-lead in the development of a national aeronautics policy in cooperation with other government agencies. She most recently served as the NASA Administrator's senior adviser for aeronautics.

Porter came to the agency following her service as senior scientist in the Advanced Technology Office of the Defense Advanced Research Projects Agency in Arlington, Va. While there, she created and managed programs in diverse technical areas ranging from fundamental scientific research to multi-disciplinary systems-level development and integration efforts. Two of her programs focused on developing physics-based predictive design tools that leveraged advanced computational fluid dynamics.

The Helicopter Quieting Program, focused on developing the capability to design quiet rotor blades with minimal impact on aircraft performance. The Friction Drag Reduction Program focused on developing the capability to implement friction drag reduction technologies on naval platforms.

Porter has a Bachelor's degree in nuclear engineering from the Massachusetts Institute of Technology, Cambridge, Mass., and a doctorate in applied physics from Stanford University, Calif. She was a lecturer and postdoctoral research associate at MIT. She received the Alpha Nu Sigma MIT Student Chapter Outstanding Teaching Award in 1996. She has authored more than 25 publications in a broad range of technical disciplines including nuclear engineering, solar physics, plasma physics, computational materials modeling, explosives detection and vibration control of flexible structures.

Mr. EHLERS. [Presiding] Thank you, Dr. Porter. And before we proceed, I apologize. Before the shuffle up here, Mr. Hall asked me to fill in temporarily and to give you his apologies. He had to step to another meeting and I expect he will be back shortly. I am truly filling in, in sense, improperly. I am not even a Member of the Subcommittee, although I am a Member of the Full Committee, but I have a strong interest in this topic, partly because I am also in the Aviation Subcommittee. I was told I could give an opening statement. I don't want to interrupt by getting into a long statement, but I simply will say that I recognize and appreciate, and have for some time, the incredible importance of the topic today and the work that you are doing. The public doesn't realize that, but it is absolutely essential. We have an outstanding safety record, but we have some very major looming problems, which the airlines, given their current financial situation, are not able to handle on their own. Neither are the airports. And it is going to take an overall federal program.

I was amused last week when I got on a flight and the pilot went through the usual welcoming procedure and he said, we know that you have a choice of many different bankrupt airlines and we thank you for choosing ours. So that indicates the financial situation we are dealing with. What makes it worse is that we in the government, and I—by that I include the Congress as well, but also the Administration, we have been starving the FAA in a number of areas. We have—although we have given a lot of money to the Department of Transportation for surface transportation, it is a notably small amount of money set aside for research and policy planning, and I am sure you recognize that as well, Mr. Shane.

In addition, there is—there are some major looming problems on the horizon in terms of capacity, and I am less worried about airport capacity than I am about airspace capacity, particularly if the very light jet movement takes off the way people thinks it will and begins making use of some of the smaller less used airports, we are going to have an entirely different air traffic situation to deal with. It is not impossible. It may not even be hard, but it takes resources to plan that. And it is because of all these different things happening in a poor economic climate, both within the industry and the Nation and particularly the government. Your job is going to

be very, very difficult, and I hope the public realizes what is at stake here and the importance of doing it. We have an outstandingly low accident record in this country. Even the record for general aviation has gone down remarkably the last several years, and I am pleased—they will be at the table, although I would rather have them in a more active role than being observers, but it is very important for them to be there as well, because that is where a lot of the growth in traffic is going to come from.

So we have our work cut out for us, and you, especially, have your work cut out for you. I am looking forward to the product and I am just very thankful that you are here to tell us what some of the issues are going to be.

With that we will proceed. Mr. Pearce.

STATEMENT OF MR. ROBERT A. PEARCE, ACTING DIRECTOR, JOINT PLANNING AND DEVELOPMENT OFFICE, FEDERAL AVIATION ADMINISTRATION

Mr. PEARCE. Thank you for the opportunity to testify with Under Secretary Shane and the other distinguished witnesses today. I would like to thank you, Mr. Chairman, and the other Members of the Committee for the opportunity as well. This committee has been with us every step of the way, even before the enactment of *Vision 100,* and we are most grateful for that continued leadership and support. Under Secretary Shane provided an excellent overview of our progress to date and a glimpse of what that future system, it will look like as we begin this transformation.

I am going to give you the bottom line. The bottom line is, we have outlined a credible future system. We have done modeling and simulation to show that we—that future system can in fact meet the kind of goals that we outlined in the Integrated Plan, capacity and otherwise. We have done the road mapping to show what the pathway is to that future system, and we have programs now that are on that roadmap. In fact, as Under Secretary Shane mentioned, in the present fiscal year 2007, there are some critical initial investments on that roadmap. One is Automatic Dependent Surveillance Broadcast, which is a new more capable means of surveillance that depends on aircraft broadcasting its position to provide that information into the surveillance system. That capability, together with other capabilities such as RNP, Required Navigational Performance, will allow us to do things like reduce separation standards, eliminate low visibility as a constraint system and address critical safety issues such as runway incursions.

There is also the System Wide Information Management that was mentioned as well. This program is going to create a network approach to information management throughout the system. Today the system is very much driven by point-to-point communications, lots of hand-offs. What we want to do is create a system that overlays a network. We publish and subscribe information. More information is available to more players in the systems. It provides common situation awareness. In fact, this last year, we did a demonstration of just that. In the Washington—we network together most of the surveillance, air surveillance systems across DOD, DHS and FAA so that we could provide a common picture to all of those users, so that we could provide a mechanism for col-

laboration and communication among those operators, and make better decisions. So it is absolutely a critical key to the future system and that is now in the budget as well.

We are especially pleased with the progress NASA has made towards re-planning its program to be aligned with NGATS. I have to say, without that research, some of the more challenging high payoff aspects of the NGATS vision will go unrealized. I certainly that hope that any doubts that this is real are being dispelled. NGATS is certainly for real. The JPDO is on the job and doing business.

Today, I would like to provide the Subcommittee a brief snapshot of some areas where I believe we can make significant process—progress in the coming year and contribute to the transformation process. In fact, I think this year is really a breakthrough year for the JPDO. We have done a lot of laying the groundwork over the last several years, built some momentum and now we need to really take advantage of that hard work.

So first, I want to say that we have really built what I think is a remarkable team, with incredible depth, focus and sense of purpose. Using the *Vision 100* authorization that was given to us, we did create the NGATS Institute to bring the private sector on board, as was mentioned earlier, and we now have nearly 200 private sector participants on the IPTs and we are putting them to work. We are—we have already tasked the institute, together with the IPTs, to help us build the detailed technical definition of NGATS, building on the—what you have seen in the progress report that outlined what that future system looks like. That technical definition is going to raise as many questions as it answers, however, because we don't know what the future system is ultimately going to look like at this point. So we are also using the institute to answer some of those questions. So for example, we know satellite navigation is going to be a key capability for the future. We also know that we are going to need other navigational systems to make sure we have a fully robust system for the country. WE need to do the trade-offs and the evaluations on what the options are and have the institute bring that back to us so we can make decisions in that regard. So that is just an example of the kind of things we are going to have the institute doing.

Under Secretary Shane also mentioned the unprecedented cooperation amongst the NGATS partner agencies. It is absolutely critical that we have that partnership. One of the elements is the alignment of resources, the alignment of programs across the government. WE made an initial effort last year and saw some real success in the fiscal year 2007 budget, as I just mentioned, with respect to ADS-B, SWIM, the NASA program. In additional, I would like to mention that we are working very hard on coordinating the weather research across Commerce, DoD, FAA, NASA. We are also coordinating the System Wide Information Management, the network centric operations that I mentioned earlier, across DoD, DHS and FAA as well. So a lot of interagency activity is ongoing right now to help coordinate and help align these important activities.

This year we are already transmitted to the agencies what we believe the right portfolio is for the fiscal year 2008 and out budg-

ets. We will work with the agencies over the next several months to hone that portfolio, value it, do cost benefit analysis and so forth to come to a final resolution on what we ought to be investing in early in the transformation.

We have two very important projects scheduled for release and public comment and vetting this summer. One is the concept of operations that will put a lot more meat on the bones of what we transmitted to you in the progress report from a couple weeks ago. Over time we will continue to build out this concept of operations. Initially, it will be aircraft movement through the system. The next generation will include how passengers will move through airports and facilities. And finally it will include all the key aspects of the air transportation system.

In addition, we will release the first version of the enterprise architecture. It will contain more detail at operations level. Ultimately, it will evolve and include operational functional performance requirements that will essentially fully define the future system. That blueprint is what will allow decision-makers to put together the programs and help us transition to the next generation system, in a consistent and coordinated and cost-efficient integrated manner. It is absolutely key to achieving our mission goals. Admittedly, this is a first cut. This is a very interim process. It is going to take time. These are extremely—it is an extremely complex system. It is going to take time to fully develop that. In its first iteration, as I said before, will probably contain more questions than answers, but doing that will help us prioritize those questions, prioritize the issues, prioritize the research, get the debate underway, and really bring forward very needed enterprise engineering integration and discipline into all of this so we can go about doing this in a very cogent way.

We need to understand the cost associated with NGATS and as we build the CONOPS and the architecture, we will be better able to do that. And under the leadership of Administrator Blakey and with the help of our institute partners, we are, in fact, convening in late April the first NGATS investment analysis workshop. It will be the first of many. We will start to develop the basis and assumptions for cost estimates for the near-, mid-, and long-term. The institute will host these workshops and bring together experts together with our experts to get going on this important task. I would say that we will—we really want to get some clarity to our near-term cost estimates and then, over time, understand what the long-term might look like, depending on the various options that are available to us.

Finally, I would like to say that we are taking on a great international focus. We have—because this is a global system, it is going to have to be globally harmonized, so we are starting to reach out to our international partners. We do have a strategy in that regard. We have a global harmonization IPT that is taking the lead for us. So we are actively engaged with Europe and EUROCONTROL and starting to discuss how we would cooperate with their SESAR initiative, which is a similar initiative to the JPDO and NGATS. There is been a long history of cooperation with Europe and I am sure that will serve us well in the future. Beyond Europe, we are also starting to establish cooperative activities with

Japan and China. We just got back from Japan a few weeks ago, discussing having a coordinating committee with them. And in a few weeks we will be heading off to China to establish a coordinating committee with them. Our work is cut out for us. It is a big globe and it is a small JPDO, but we do have a plan for getting out to the—and working this with the entire air traffic—air transportation community across the globe.

This concludes my statement. I believe we are really on the right track, making solid progress towards delivering a plan as well as the system itself. If we stay focused, manage risk and maintain the kind of partnership that we have really striven hard to build up over the last couple years, I am convinced that we will succeed. I will be happy to answer any questions at the appropriate time and I thank you very much for having the hearing and for having me testify.

[The prepared statement of Mr. Pearce follows:]

PREPARED STATEMENT OF ROBERT A. PEARCE

Thank you for this opportunity to testify with Under Secretary Shane at today's hearing. Let me add my thanks to you, Mr. Chairman and Ranking Member Udall and the entire Subcommittee. You have been with us every step of the way—even before the enactment of *Vision 100*. We are most grateful for your continued leadership and commitment to this historic effort.

Mr. Chairman, Under Secretary Shane provided an excellent overview of our progress to date and a glimpse into the near future as we put into place such key transformational building blocks, as ADS–B and SWIM—both of which will deliver Next Generation capabilities and benefits. I hope any lingering doubts have been dispelled; the NGATS is for real and we mean business.

And today, I would like to provide the subcommittee with a brief snapshot of five key areas where I believe we can also make significant progress in the coming year and contribute to the transformation process. Indeed, I see 2006 as a breakthrough year for the Next Generation System initiative and the JPDO. All of the initial hard work is starting to pay off and we must now sustain the momentum generated in 2005.

First, we are building a remarkable team with incredible depth, focus and sense of purpose. Following the *Vision 100* playbook, this unique public/private partnership is working together to make the NGATS vision a reality. Through the NGATS Institute, we have now recruited and placed on JPDO's eight Integrated Product Teams 200 of the best and brightest individuals from 70 different organizations. In 2006, we will expand this participation; and it can't come too soon.

We have already begun tasking the Institute and IPTs with real work that has a direct impact on the Next Generation System. For example, we know that satellite navigation will be a key enabling technology. But we also know that the U.S. must take definitive action this year on a GPS backup, as Europe must similarly do with Galileo. We have now asked the Institute to perform the research and recommend a fall-back mode, whether it's LORAN or another technology.

And under the leadership of Administrator Blakey, the JPDO is convening on April 19–20th the first NGATS Investment Analysis Workshop to develop the basis for cost estimates for the initiative's near-, mid-, and long-term development. We have asked the Institute to recruit the needed experts from across aviation to make this critical endeavor a success.

Second, Under Secretary Shane spoke about the unprecedented cooperation among the NGATS partner agencies. One critical part of that effort is the alignment of activities and resources towards the Next Generation System. To this end, in early summer of 2006, JPDO will provide thorough FY 2008 planning and programming guidance to each of the participating agencies—a major milestone. That way we are all pulling together and maximizing investments.

Third, using this guidance, we can in turn create and implement portfolio management and build business cases against it. This will allow us to begin moving beyond the FAA's Operational Evolution Plan to the Next Generation System.

Fourth, we have two very important products scheduled for release and public comment and vetting this summer. The first is the Concept of Operations which de-

scribes how the future system is operated and how we move passengers from airport curb to airport curb.

We will also release the first version of an Enterprise Architecture that will contain Concepts of Use. This high-level blueprint will help decision-makers better understand the complexity of operations and allow us to successfully transition to the Next Generation System in a consistent, coordinated, cost-efficient and integrated manner. It is key to achieving mission goals. Admittedly this first cut will contain more questions than answers, but it will help foster greater debate and drive research and a much needed enterprise engineering integration discipline.

Fifth, JPDO will take on a greater international focus. To help ensure global inter-operability, we are actively engaged in a number of cooperative activities with EUROCONTROL, such as a forthcoming meeting where we will compare NGATS and SESAR technology and concepts of use. NASA is also working closely with EUROCONTROL to coordinate R&D activities. In addition, EUROCONTROL is sending over a senior technical representative whose work will involve coordination of programs such as SESAR. And beyond Europe, JPDO is beginning to establish cooperative activities with Japan and China. Our work is clearly cut out as more countries transform their ATM systems.

Mr. Chairman, this concludes my statement. I believe we are solidly on the right track and making solid progress towards delivering the Next Generation System. If we stay focused and manage risk, I am convinced we will succeed. I would be happy to answer your questions. Thank you.

BIOGRAPHY FOR ROBERT A. PEARCE

Prior to becoming the JPDO Deputy Director, Bob Pearce was responsible for strategic planning and analysis and top-level requirements definition for NASA's Aerospace Technology Enterprise. As such, he led the Enterprise's strategic management efforts, ensuring the development and maintenance of long-term strategic goals, investment strategies, development of responsive programs, and evaluation of program progress against the strategic goals.

Previously, he held various program management positions within the Enterprise, primarily focused on high-performance aircraft systems and experimental flight research. Before joining NASA, Bob was employed by Grumman Corporation as a design aerodynamics engineer, working on advanced military aircraft and concepts, including the X–29 forward swept wing demonstrator.

In addition, Bob worked with the Department of Transportation to examine the technology, policy and economic issues associated with new technologies for short-haul inter-city transportation.

Mr. EHLERS. And thank you very much. Next we turn to the people who always know what we are doing wrong, the inspector general, Mr. Dobbs.

STATEMENT OF MR. DAVID A. DOBBS, ASSISTANT INSPECTOR GENERAL FOR AVIATION AND SPECIAL PROGRAM AUDITS, U.S. DEPARTMENT OF TRANSPORTATION

Mr. DOBBS. Thank you. Mr. Chairman and Members of this subcommittee, I appreciate the opportunity to discuss the JPDO and——

Mr. EHLERS. Is your microphone on?

Mr. DOBBS. I think so, yeah.

Mr. EHLERS. Can you pull it closer, please?

Mr. DOBBS. Is this better?

Mr. EHLERS. Yes.

Mr. DOBBS. Okay. I appreciate the opportunity to discuss the JPDO and plans for the next generation system. You have heard testimony already about the JPDO's important mission to develop a vision for the Next Generation Air Transportation System and coordinate diverse agency research efforts. Today I would like to limit my testimony to three points regarding the JPDO.

First the role the JPDO has in leveraging resources for the next generation system. While there is considerable debate about how to finance FAA, there is almost universal agreement that changes are needed to meet the demand for air travel. Last year over 700 million passengers used the system and this number is forecasted to grow to over one billion by 2015. The current system was not designed to handle that level of traffic. A multi-agency approach is critical for a number of reasons besides enhancing capacity. One, FAA does not conduct much long-term research. Almost 70 percent of FAA's $130 million request for research focuses on just safety research. Two, most of FAA's current $2.5 billion capital account focuses on keeping things running and not new initiatives, and only about 55 percent of that account actually goes for systems.

Both NASA and FAA face budget reductions like a lot of agencies, but particularly for aviation research in their case. The key for the JPDO in today's deficit environment is leveraging scarce resources. Business as usual won't work to meet the demands for air travel and get new systems on line. Despite the tight budget, FAA is requesting funds in 2007 for two important efforts that have been discussed today already, AS—ADS-B and SWIM. Mr. Shane discussed these programs just a few moments ago. They are considered important building blocks for the next system. They are not new systems and we have seen them in previous budgets before. An important point here is that FAA will have to look at its existing acquisition portfolio and determine what modifications need to be made given JPDO's plans.

My second point is what progress is being made—while—excuse me—while progress is being made, considerable work remains to align agency budgets. Central to the JPDO's mission is the alignment of these—of resources. This is a complex task. Each agency conducts research principally for its own mission. A majority of the JPDO's work is done through integrated product teams, as you have just heard, that focuses on strategies to revamp the current system, such as NASA's work to develop the automated system to boost controller productivity. FAA has not planned nor budgeted for this type of research. Accordingly, NASA will need a much clearer picture of FAA's requirements and when prototypes will be needed to better support the JPDO. The JPDO expects to do much more on this front in time for the 2008 budget, as you have heard from Mr. Pearce. But today it is hard to assess alignment because JPDO's progress reports do not provide details on ongoing research projects, their budgets or other agencies.

My third point focuses on what the actions needed to move forward. One is leadership. The position of the JPDO director is currently vacant. FAA needs to find the right person to lead this effort, particularly given that the JPDO has not authority to redirect agency resources. Second is developing and implementing mechanisms for alignment, which you have heard a little bit about today. The JPDO is working with the Office of Management and Budget to develop an integrated budget document that provides a single business case that will help align efforts. As part of this, the JPDO has promised to provide OMB, in the next several months, hopefully by this summer, an architecture for the next generation system, as well as a list of programs and other agency budgets it in-

tends to leverage. This is important, because NGATS's architect will help support decisions, adjust plans, track commitments, and will also help define costs. However, until these actions are taken, it will be difficult for the Congress and aviation stakeholders to determine if the JPDO is leveraging the right research, if funding is adequate, or how projects will improve the U.S. transportation system and at what cost.

Finally, conducting sufficient human factors research to support anticipated changes. The JPDO is planning to make fundamental changes in how the system operates and how controllers manage traffic. History has shown that insufficient attention to human factors can increase the cost of acquisition and delay much needed benefits. For example, problems in the late 1990s with FAA's Standard Terminal Automation Replacement System, also known as STARS, were directly traceable to not involving users early enough in the process. The JPDO also envisions changing the role to, the pilot's role, and accordingly, human factors will be extremely important.

Mr. Chairman, that concludes my statement. I will be happy to answer any questions you or Members of the Subcommittee may have.

[The prepared statement of Mr. Dobbs follows:]

PREPARED STATEMENT OF DAVID A. DOBBS

Mr. Chairman and Members of the Subcommittee:

We appreciate the opportunity to testify on the Federal Aviation Administration's (FAA) *Joint Planning and Development Office* (JPDO) and the plans for the next generation air transportation system. Secretary Mineta has made these efforts a top priority.

The JPDO was mandated by Congress to develop a vision for the next generation air transportation system (NGATS) in the 2025 timeframe and coordinate diverse agency research efforts. This office was established within FAA, and the National Aeronautics and Space Administration (NASA), the Department of Commerce, the Department of Defense (DOD), and the Department of Homeland Security are participating in the JPDO. Thus far, we have focused primarily on the JPDO's air traffic management efforts that involve NASA, DOD, and Commerce.

There are a number of compelling reasons for moving toward the next generation air transportation system. The current air transportation system has served the Nation well but FAA reports that the current system (or business as usual) will not be sufficient to meet the anticipated demand for air travel or changes in the industry. Last year, over 700 million passengers used the system, and this number is forecasted to grow to over one billion by 2015. It is also important because much of FAA's current capital investment focuses on keeping things running—not new initiatives.

In addition, there is an issue on the horizon that could have tremendous implications for air traffic control—micro-jets (relatively inexpensive aircraft that seat four to five people). FAA expects that over 100 micro jets will enter service next year, growing by 400 to 500 per year through 2017.

Because of the forecasted growth in air travel, the JPDO needs to continue to work on what can be done much sooner than the 2025 timeframe. We made this point last year, and the JPDO is working on what new systems and procedures can be fast tracked. It will be important for the JPDO to show tangible benefits to airspace users from its efforts.

Overall, we found that progress has been made with the JPDO since the office was established two years ago. The JPDO has established eight integrated product teams, set up an NGATS institute to interface with industry, and provided Congress with two progress reports. However, the cost and schedule of the next system remains unknown, and considerable work remains to align Agency budgets and plans.

Today, I would like to focus on three points:

- The JPDO's critical role in leveraging resources for the next generation air transportation system.
- Progress and challenges to date in aligning Agency budgets and plans.
- Actions that will help the JPDO keep moving forward in both the short- and long-term.

The Important Role the JPDO Has in Leveraging Resources for the Next Generation Air Transportation System

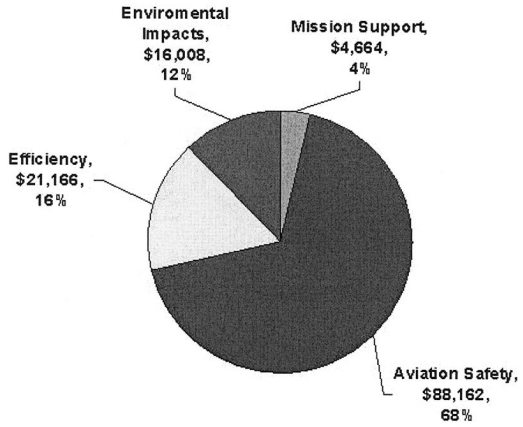
The JPDO is expected to develop a vision for the next generation system and has established ambitious, much needed goals to accommodate three times more air traffic and reduce FAA operating costs. The JPDO also expects a shift from today's ground-based system to an aircraft-based system and to obtain significant controller productivity enhancements through automation. To do so, a multi-agency approach—as outlined in *Vision 100*—is critical given the current deficit environment, competition for federal funds, and FAA's tight budget. Moreover, leveraging of scare resources is essential to get the most from each federal research dollar and prevent duplication.

There are a number of other reasons why the JPDO is looking to other agencies, including the fact that FAA does not conduct much long-term air traffic management research. Further, most of its current $2.5 billion capital account goes for keeping things running (sustainment), not new initiatives.

FAA's FY 2007 Budget Request for Research, Engineering, and Development

FAA is requesting $130 million for FY 2007, a decrease of $6.6 million from last year's appropriated level of $136.6 million. This includes $18 million specifically for the JPDO. Figure 1 illustrates the makeup of the FY 2007 request by major lines of effort.

Figure 1. FAA FY 2007 Budget Submission for R,E & D (in Millions)
$130 Million



As shown above, almost 70 percent of FAA's research budget, or $88 million, focuses on improving safety—not new air traffic management initiatives. This includes projects on fire safety and aging aircraft systems, which focus on preventing accidents and making them more survivable. The remaining funds are requested for efficiency, environmental research, and mission support efforts.

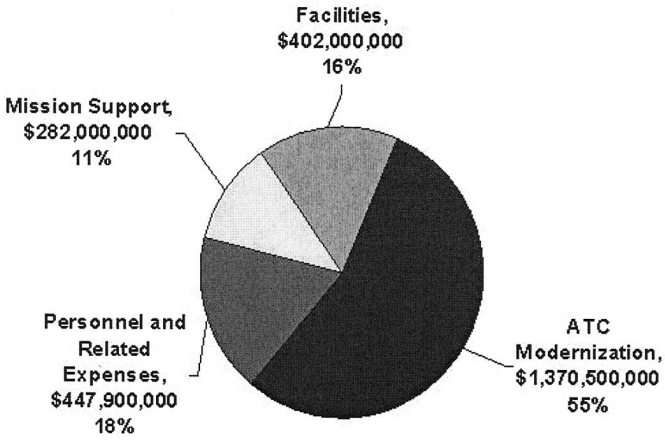
FAA is also requesting research funds from its airport account for safety and efficiency issues. FAA is requesting $17.8 million in FY 2007 for research in the areas of, among other things, airport pavement and airport markings. In addition, FAA is requesting $10 million in FY 2007 for airport cooperative research projects with airports, including efforts to enhance safety and improve airport lighting.

Perspectives on FAA's Capital Account

FAA's capital account—or the Facilities and Equipment (F&E) account—is the principal vehicle for modernizing the National Airspace System. It represents about 18 percent of the Agency's FY 2007 budget request of $13.7 billion. For FY 2007, FAA is requesting $2.5 billion for the F&E account, which is $50 million less than last year's appropriation. FAA has a long history of cost growth, schedule slips, and performance shortfalls with its air traffic control modernization efforts.

As illustrated in Figure 2, only about 55 percent of FAA's FY 2007 request for F&E (or $1.4 billion) will actually go for acquiring air traffic control systems. The remaining funds will be spent on personnel, mission support, and facilities.

Figure 2. FAA's FY 2007 Facilities and Equipment



As we have noted in the past, the majority of FAA's capital account now goes for keeping things running (i.e., sustainment), not new initiatives. A review of the top 10 projects by dollar amount in the FY 2007 request shows some projects will form important platforms for JPDO initiatives. For example, the $2.1 billion *En Route Automation Replacement Program* is replacing the current software and hardware for facilities that manage high-altitude traffic. Attachment A provides details on key, ongoing modernization programs that will likely play a role in JPDO efforts.

However, the bulk of funds are requested for projects that have been delayed for years, as well as for efforts to improve or maintain FAA facilities or replace existing radars. It is important to recognize that FAA's existing investments will heavily influence NGATS requirements and schedule. FAA will have to assess how JPDO plans affect ongoing acquisition projects and determine which ones need to be accelerated or re-scoped.

These are a number of reasons why there is so much discussion about the next generation air traffic management system. For example, over the last several years, FAA has deferred or canceled a number of projects as funding for the capital account has remained essentially flat. This includes efforts for a new air-to-ground communication system, controller-pilot data link communications, and a new satellite-based precision landing system.

Notwithstanding a tight budget, FAA is requesting funds for two projects in the F&E account that are considered "building blocks" for the next generation system and have potential for enhancing capacity and reducing delays. These are not new programs, per se, and have been under development or been funded in previous budgets.

- *Automatic Dependent Surveillance–Broadcast (ADS–B)* is a satellite-based technology that allows aircraft to broadcast their position to others. In FY 2007, FAA is requesting $80 million for this satellite-based technology. In prior budgets, ADS–B was funded under the *Safe Flight 21 Initiative,* which demonstrated the potential of ADS–B and cockpit displays in Alaska and the

Ohio River Valley. FAA expects to make a decision about how quickly to implement ADS–B and at what cost later this year. Airspace users will have to equip with the new avionics to get benefits, and FAA may have to rely on rule-making initiatives to help speed equipage. This illustrates why the JPDO must address complex policy issues as well as research.

- *System Wide Information Management (SWIM)* is a new network information architecture that will allow airspace users to access a wide range of information on the status of the National Airspace System and weather conditions securely and seamlessly. It is analogous to an Internet system for all airspace users. FAA is requesting $24 million for this program in FY 2007.

FAA Has Historically Relied on NASA for Long-term Air Traffic Management Research

NASA makes a significant investment in aviation research and is requesting $724 million for aeronautics research in FY 2007, less than last year's appropriated level of $884 million. Although NASA is in the process of restructuring its aeronautics research portfolio, officials are committed to supporting JPDO efforts. Table 1 illustrates NASA investments in aeronautics research for FY 2005 and FY 2006, as well as its request for FY 2007.

Table 1. NASA Funding For Aeronautics Research (Dollars in Millions)

NASA Aeronautics Research	FY 2005 Operating Plan	FY 2006 Operating Plan	FY 2007 Budget Request
Fundamental Aeronautics	$630	$562	$447
Airspace Systems	149	174	120
Aviation Safety	183	148	102
Aeronautics Test Program	0	0	55
Total	**$962**	**$884**	**$724**

Source: NASA

FAA had close ties with NASA *before* the establishment of the JPDO, and we see this relationship continuing. FAA and NASA have different roles. While FAA focuses its research and development efforts (in both the research and capital accounts) on the near-term, NASA focuses on long-term, cutting-edge technologies. In fact, NASA has conducted the majority of long-term research for air traffic management. FAA has also looked to DOD in the past for developing aerospace concepts and technologies, including the Global Positioning System. Attachment B provides information on potential agency contributions to the JPDO and each agency's areas of expertise.

Progress Is Being Made in Coordinating Diverse Agency Efforts but Considerable Work Remains To Align Agency Budgets and Plans

The law requires the JPDO to coordinate and oversee research that could play a role in NGATS. Central to the JPDO's mission—and making it an effective multi-agency vehicle—is alignment of agency resources. This is a complex task, and the law provides no authority for the JPDO to redirect agency resources.

The Secretary of Transportation has played an important role in coordinating various efforts by chairing the *Senior Policy Committee.* This committee was established by *Vision 100* and includes, among others, deputy secretary level representatives from Commerce and Homeland Security, as well as the Secretary of the Air Force. It also includes the FAA and NASA Administrators. This committee provides

high-level guidance, resolves policy issues, and identifies resource needs. Each participating agency conducts research tailored for its specific mission.

The JPDO's March 2006 progress report to Congress outlined various accomplishments to date, including the establishment of multi-agency teams and the NGATS institute (a mechanism for interfacing with the private sector). However, the report did not provide details on specific ongoing research projects or funding that the JPDO expects to leverage at FAA or other agencies. Without this information, it is difficult to assess progress with alignment of budgets.

The majority of JPDO's work is done through eight *Integrated Product Teams* (IPT) that focus on eight strategies, such as how to use weather information to improve the performance of the National Airspace System. The teams are composed of FAA, other federal agencies, and the private sector. Attachment C provides details on the JPDO's IPTs and their major areas of emphasis.

The National Research Council recently examined JPDO plans and was critical of the IPT structure. The Council's report found that even though the teams have multi-agency participation, they are functioning primarily as experts in specific disciplines rather than as cross-functional, integrated, multidisciplinary teams organized to deliver specific products. One of the report's recommendations was that the IPTs be reduced in number and made more "product driven." Although we have not reached any conclusions on how to best structure the IPTs, we do agree that a more product-driven focus would be an important step forward.

Our work on three important IPTs shows that there is considerable coordination but little alignment of agency budgets to date. Moreover, the IPT leaders have no authority to commit agency resources to JPDO efforts and often have no products other than plans. The following illustrates progress and challenges to date with the three IPTs we examined in detail.

- *The Weather IPT* is led by the National Oceanic Atmospheric Administration (NOAA), an agency of the Department of Commerce. FAA, NASA, DOD, and NOAA are all conducting weather research tailored for their specific missions. Thus far, this team's efforts have focused on contributions to FAA's *Traffic Flow Management Program* (which assists traffic managers to optimize air traffic by working with airlines). NOAA is also helping the JPDO refine its concept of a fully automated system. Integrating new, up-to-date weather forecast systems into planned automation efforts will be challenging.

  We note that JPDO has not yet determined if a considerable amount of applied research and development conducted by NOAA at the Office of Atmospheric Research and the National Environmental Satellite Data and Information Service could be leveraged for next generation initiatives. We have shared our concerns about effectively leveraging weather research with the JPDO, which recognizes it can do a better job.

- *The Shared Situational Awareness IPT* is led by DOD. All participating agencies are adopting network-centric systems.[1] As noted earlier, FAA is developing its own network system called SWIM. While there are considerable opportunities for leveraging net-centric efforts, there is also potential for duplication of effort. Challenges here focus on taking an approach pioneered by DOD and applying it specifically to air traffic control to get benefits in terms of enhanced capacity and delay reduction.

  An active role by DOD is vital because it is both a provider and a consumer of air traffic services. Thus far, work with this IPT has focused almost exclusively on maximizing agency network capabilities in DOD, such as the *Global Information Grid,* which is a net-centric communication system DOD is developing for global use. Moreover, DOD's real-world experiences and lessons learned in sharing data (from air and ground systems) in actual operations and in real-time have not been tapped and will prove invaluable in reducing cost and technical risks in developing the next generation system.

- *The Air Traffic Management IPT* is led by NASA. It is expected to play a key role by helping develop the automated systems to boost controller productivity. FAA has neither planned nor budgeted for this type of research. Major challenges focus on establishing requirements and gaining a full understanding of the risks associated with developing and acquiring these new software-intensive systems before making financial commitments. This is important because future automation efforts will be a major cost driver for the next generation system.

[1] A net-centric system uses Internet protocols to transfer data.

We see potential for the most progress with coordination and alignment between the JPDO and NASA. Even though NASA is restructuring its aeronautical research program and spending less than in the past, the JPDO and NASA are working on several complex concepts for new automation systems and the timing of research efforts. This work will be funded via NASA efforts associated with "airspace systems." However, experience shows that NASA will need a much clearer picture of FAA's requirements—and when prototypes would be needed—to better support the next generation system.

Several Actions Are Critical for the JPDO To Make Progress in Both the Short- and Long-Term

Key questions for FAA and the JPDO focus on what the new office can deliver, when, and how much it will cost. They are central questions in the discussion about how to best finance FAA and will shape the size, requirements, and direction of the capital program for the next decade. We understand that the JPDO is planning to conduct workshops with industry to help determine the costs, requirements, and milestones associated with the next generation system.

Moving to the next generation system is important to meet the demand for air travel, change the way FAA provides services, and reduce Agency costs. However, it is also a high-risk effort, given the complexity of the task and the policy and regulatory issues that must be addressed. To make progress, several steps are needed.

- *Leadership.* The position of the JPDO Director is currently vacant—FAA needs to find the right person to lead this effort. The JPDO does not have authority to redirect agency resources. The former JPDO director was also the director of the Air Traffic Organization's (ATO) planning organization. We think experience has shown that one person cannot effectively do both jobs because of complex technical issues and important policy decisions facing FAA and the JPDO. Leadership will be important to bridge the gap between the ATO's near-term planning horizon and the JPDO's longer-term mission to transform the National Airspace System.
- *Developing and Implementing Mechanisms for Alignment.* As noted earlier, much work remains to align agency budgets. There is a need for mechanisms to help the JPDO align diverse agency efforts over the long haul.

  The JPDO recognizes that more needs to be done and is working with the Office of Management and Budget (OMB) to develop an integrated budget document that provides a single business case (a document similar to the "OMB Form 300") to make sure efforts are indeed aligned.[2] As part of this, JPDO has promised to provide OMB in the next several months with an architecture for the next generation system, as well as a specific list of programs in other agency budgets it intends to leverage. We will follow up on this step during our ongoing audit.

  JPDO's ongoing efforts to develop an *enterprise architecture,*[3] or overall blueprint for the next generation system, will help in setting goals, supporting decisions, adjusting plans, and tracking agency commitments. The architecture will also show requirements from FAA and the Departments of Defense and Homeland Security and where various agency efforts fit in the next generation system. It will prove helpful in the future in resolving difficult policy decisions, including who pays for what elements of the system.

  JPDO is taking an incremental approach to architecture development and plans to have an initial version this summer. However, considerable work remains to link current systems with future capabilities and develop technical requirements, particularly for new concepts for automation.

  Until these actions are taken, it will be difficult for the Congress and aviation stakeholders to determine if the JPDO is leveraging the right research, if funding is adequate for specific efforts, or how projects will improve the U.S. air transportation system and at what cost. Therefore, we think the JPDO should include in its periodic reports to Congress a table of specific research projects with budget data of other agencies it is leveraging and how that ongoing research is supporting the JPDO.

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[2] OMB Form 300 was established as a source of information on which decisions about budgetary resources consistent with Administration priorities, planning, management and use of capital investments are consistent with OMB policy and guidance.

[3] Enterprise Architecture can be viewed as a blueprint that links an enterprise's strategic plan to the programs and supporting systems in terms of interrelated business processes, rules, and information needs. This includes the transition from the "as-is" to the "to-be" environment.

- *Examining Barriers to Transforming the National Airspace System That Have Impacted Past FAA Programs and How They Can Be Overcome.* Our work on many major acquisitions shows the importance of clearly defined transition paths, expected costs (for both FAA and airspace users), and benefits in terms of reduced delays. This is particularly the case for initiatives that call airspace users to equip with new avionics.

  For example, FAA canceled the controller-pilot data link communications program specifically because of uncertain benefits, concerns about user equipage, cost growth, and the impact on the Agency's operations account. The inability to synchronize data link with other modernization efforts, such as the multi-billion dollar *En Route Automation Replacement Program* was also a factor.

  Other critical barriers to be overcome include how to ensure new systems are certified as safe for pilots to use and getting the critical expertise in place at the right time. Problems with FAA's multi-billion *Wide Area Augmentation System* (a new satellite navigation system) that led to cost growth and schedule slips were directly traceable to problems in certifying the new satellite-based system.
- *Developing a Strategy for Technology Transfer.* Technology transfer—the movement of technology from one organization to another—is a central issue for the JPDO because the law envisions new capabilities developed by other federal agencies (or the private sector) being transitioned into the National Airspace System. The JPDO will have to pay greater attention to this matter as it moves forward.

  Our past work shows that FAA has experienced mixed success in transitioning systems developed by others into the National Airspace System. For example, FAA ultimately abandoned work on a new controller tool developed by NASA (the Passive Final Approach and Spacing Tool) for sequencing and assigning runways to aircraft because of complex software development and cost issues. As we noted in our review of FAA's Free Flight Phase 1 Program, the use of "technology readiness levels" could be useful to help assess maturity of systems and ease issues associated with the transfer of technology. Both NASA and DOD have experience with categorizing technical maturity. This could help reduce cost, schedule, and technical risk with implementing JPDO initiatives.
- *Conducting Sufficient Human Factors Research To Support Anticipated Changes.* The JPDO is planning to make fundamental changes in how the system operates and how controllers manage traffic to accommodate three times more aircraft in the system. Currently, the union that represents controllers is not yet participating in JPDO efforts for a variety of reasons.

  History has shown that insufficient attention to human factors can increase the cost of acquisition and delay much needed benefits. For example, problems in the late 1990s with FAA's *Standard Terminal Automation Replacement System* were directly traceable to not involving users early enough in the process.

  The need for focused human factors research extends well beyond the traditional computer-machine interface (such as new controller displays) and has important workforce and safety implications. For example, FAA expects the controller's role to change from direct, tactical control of aircraft to one of overall traffic management. There also will be significant human factors concerns for pilots, who will be expected to rely more on data link communications. It will be important to have sufficient human factors analysis and studies to ensure that the changes envisioned by the JPDO can be safely accommodated.

Mr. Chairman, that concludes my statement. I would be happy to answer any questions you or other Members of this subcommittee might have.

Attachment A. Key Platforms

System	Status and Key Issues
Terminal Modernization: Standard Terminal Automation Replacement System (STARS), Common Automated Radar Terminal System (Common ARTS): Controller work-stations that process surveillance data and display it on the screen to manage air traffic in the terminal environment.	FAA has struggled with how to complete terminal modernization. STARS, which so far has cost of $1.3 billion for only 47 sites, was envisioned as the centerpiece of terminal modernization. Because of technical problems and schedule delays with it, FAA decided to deploy another system, Common ARTS, as an interim solution at over 140 facilities in several configurations. FAA is rethinking its approach to terminal modernization and recently decided to field STARS to only 5 additional sites. A decision affecting the remaining 100-plus sites has been postponed for over a year. FAA needs to resolve how it will complete terminal modernization and what additional capabilities will be needed as it works with the JPDO.
En Route Automation Modernization (ERAM): Replaces the Host computer hardware and software (including the Host backup system) and associated support infrastructure at 20 En Route Centers.	With an estimated cost of $2.1 billion, ERAM is one of the largest and most complex acquisitions in FAA's modernization portfolio. Progress is being made with the first ERAM deliverable—a backup system for the Host computer. However, the bulk of the work focuses on development of the first major ERAM software release, which involves developing over 1 million lines of code. A number of new capabilities (dynamic airspace management and data link) depend on future enhancements to ERAM that have yet to be defined or priced.

Attachment A. Key Platforms (continued)

System	Status and Key Issues
FAA Telecommunications Infrastructure (FTI): FTI is designed to replace existing telecommunications networks with one new network through a phased process. A single provider is responsible for acquiring, operating and maintaining the new telecommunications infrastructure.	FTI is FAA's effort to transition from multiple telecommunication networks to a single new network for the purpose of reducing operating costs. FTI is expected to replace about 25,000 existing telecommunications services and circuits at more than 4,400 facilities. FAA re-baselined FTI in December 2004, increasing lifecycle costs from $1.9 billion to $2.4 billion and adding 5 years to the life of the program. However, FTI is not likely to be completed on schedule in December 2007 because FAA does not have a realistic master schedule or effective transition plan identifying when each site and service will be accepted, when services will be cut over to FTI, and when existing services will be disconnected. Through the end of FY 2005, FTI equipment was installed at about 700 sites, and only about 3 percent of the 25,000 FTI services were operational, leaving a vast amount of costly existing equipment still being sustained. As a result, expected FTI cost reduction benefits are eroding. To address the schedule risk, FAA needs to develop a realistic master schedule and incorporate it into the FTI contract to hold the prime contractor accountable. Successful FTI implementation is critical to many other programs such as System Wide Information Management (SWIM) system and ERAM.
Traffic Flow Management (TFM) is an FAA initiative to modernize the hardware and software used to manage the flow of air traffic.	TFM Infrastructure products and services are designed to support the Traffic Management Specialists (TMS) and Traffic Management Coordinators (TMC) to optimize air traffic flow across the National Air Space System. The TMS and TMC planners analyze, plan, and coordinate air traffic flow through continuous coordination with the airlines and the use of surveillance sources, weather, automation, and display subsystems.

Attachment B. Potential Agency Contributions

The following table provides perspectives on the wide range of research being conducted at agencies for their specific missions that participate in the JPDO. We note that only some of the ongoing research will be applicable to the JPDO's efforts.

Agency	Key Area of Leverage
DOD	DOD has an extensive and diverse Research and Development (R&D) base, including research in new aircraft, composites, imaging systems, and data exchange systems for all services. DOD has requested $73.1 billion overall for R&D in FY 2007. The JPDO is particularly interested in DOD's broadband communication networks, such as the *Global Information Grid.* DOD planned upgrades to the Global Positioning System Constellation will be critical to civil aviation.
Commerce / NOAA	Commerce is requesting $1.06 billion for research in FY 2007. NOAA is a part of Commerce and is responsible for the National Weather Service; the National Environmental Satellite, Data and Information Service; and Oceanic and Atmospheric Research. NOAA requested $533 million in FY 2007 for R&D. The JPDO is seeking from NOAA probability weighted forecast capabilities, a national uniform weather database of forecasts and observations, and transparent automatic adjusted traffic management for weather.
NASA	For years, NASA has conducted the majority of long-term Air Traffic Management research, including automated controller tools and human factors work. NASA has requested $724 million for FY 2007 on aeronautical R&D. The JPDO is looking to NASA to develop automated aircraft metering and sequencing, and dynamic airspace reconfiguration.
Department of Homeland Security (DHS)	DHS contributes expertise in the areas of security and net-centric initiatives. The Agency has requested $1 billion in FY 2007 for Science and Technology R&D. FAA is looking to DHS to develop automated passenger and cargo screening, hardened aircraft security, and flight control overrides.

Attachment C. Integrated Product Teams

IPTs are multi-agency teams that are defining the specific concepts, and capabilities and coordinating the actions necessary to make possible the transformation in each of the eight strategies articulated in the NGATS Integrated Plan.

1. Develop Airport Infrastructure To Meet the Future Demand—FAA
2. Establish an Effective Security System Without Limiting Mobility or Civil Liberties—DHS
3. Establish an Agile Air Traffic System—NASA
4. Establish User-Specific Situational Awareness—DOD
5. Establish a Comprehensive Proactive Safety Management Approach—FAA
6. Develop Environmental Protection That Allows Sustained Aviation Growth—FAA
7. Develop a System-Wide Capability To Reduce Weather Impacts—Commerce/NOAA
8. Harmonize Equipage and Operations Globally—FAA

BIOGRAPHY FOR DAVID A. DOBBS

Mr. Dobbs was appointed to his current position with the Office of Inspector General, U.S. Department of Transportation, in February 2000. Mr. Dobbs is responsible for the overall management and supervision of auditing and evaluating activities relative to aviation programs, functions, and operations of the Department of Transportation.

Prior to his current appointment, Mr. Dobbs was the Director of Aviation Operations Audits and prior to that the Director of Department-wide Audits with the Department of Transportation's Office of Inspector General. Mr. Dobbs has managed numerous reviews on FAA's Air Traffic Organization including personnel reform, ATC labor agreements, modernization efforts, and financing issues. In addition, Mr. Dobbs has directed a wide-range of reviews on FAA's safety oversight of the airline industry and the Agency airport improvement programs.

Mr. Dobbs is a graduate of the University of Oregon and resides in Fairfax Station, Virginia.

Mr. HALL. Mr. Dobbs, thank you very much and we will give you a chance to do that in just a little bit. I recognize now Mr. Mike Hudson, the Chairman of the Committee on Technology Pathways, Assessing the Integrated Plan for N-G-A-T-S, NGATS, the National Research Council. I will recognize you, Mr. Hudson.

STATEMENT OF MR. S. MICHAEL HUDSON, CHAIRMAN, COMMITTEE ON TECHNOLOGY PATHWAYS, DIVISION ON ENGINEERING AND PHYSICAL SCIENCES, NATIONAL RESEARCH COUNCIL, THE NATIONAL ACADEMIES

Mr. HUDSON. I believe I have got the mike on. I think I do. As you noted, I am here, since I was the chair of NRC's committee assessing the JPDO plan. Before we address this, we looked at the two tasks that they had been assigned. One was the development of the plan itself, the other was to oversee and coordinate the necessary research among the federal and private—federal agencies and private industries. Our assessment was that they are working with limited authority and limited fiscal resources to get this job done during the period of time that we made our review. We thought that the integrated product teams involved all of the interested agencies, and it ensured that the people who had the responsibility for implementing pieces of the system were directly involved.

These initials IPTs, the initial IPT structure addressed the complexity of the problem, but it was our feeling that they should eventually evolve into a more a operational product-oriented group of

IPTs. The—you asked the question, who is the ultimate—who is ultimately responsible for leadership and success. It was the Committee's assessment that strong leadership is required from the senior product—I am sorry—the senior policy committee and at the JPDO level, but the ultimate responsibility lies with the Secretary of Transportation.

We were asked to comment on priorities. The committee felt that the—all of the priorities needed to be focused with the demand and the resulting increase in capacity that is required to meet the future demands. The operational concepts that we felt that the program needed to be prioritized under were airport operations, terminal area operations, and route and oceanic operations. There was the issue of global collaboration that came up. WE felt that vigorous U.S. leadership in implementing global collaboration is required to ensure the continued competitiveness of the U.S. industry. I would point out that the international language for ATC happens to be American English.

In terms of technical and programmatic challenges, you asked us to—for the biggest near and midterm technical challenges and programmatic challenges, and then what needs to be done to address these. When we looked at the technical challenges, there wasn't one single large technical challenge like cold fusion or any other stealth technology that surfaced. It was a requirement to continue the core research in a broad field—in broad fields. If we had to identify two areas, we would have said automation and human factors were the two areas that could stand directed research. Those are key, we felt, to any future system.

In terms of programmatic issues, our assessment was, in terms of resources, that currently they were inadequate, that there is a requirement for stable funding over a long period of time. We felt that the departments involved must also respect the stability, since we are dependent on the work of each of the independent departments to support the JPDO. And finally, there is a need for the public and private participation. The U.S. Government—none of the agencies involved make the equipment that is required to do the job, so ultimately there will have to be participation by the manufacturers and of course by the users themselves.

In terms of organization, we had mentioned—I had mentioned earlier that the initial IPTs were important because they did involve the various agencies. But in the long-term, it was our feeling that those needed to be consolidated and aligned with the three operational phases of air transportation, in other words, become more product oriented as product teams, not specialized in safety and other areas, which are discipline areas. The—we did go on to say, though, that the multi-agency membership is positive and they have—and it has resulted in a high degree of awareness of the technical issues.

Those were findings. They are available in the report that was published. We have provided you a summary of that report and a written testimony and we stand to answer questions as—at the appropriate time.

[The prepared statement of Mr. Hudson follows:]

PREPARED STATEMENT OF S. MICHAEL HUDSON

Assessing the Integrated Plan for a Next Generation Air Transportation System

Good afternoon, Mr. Chairman, and Members of the Committee. Thank you for the opportunity to testify before you today. My name is Michael Hudson. I retired as Vice Chairman of Rolls-Royce North America in 2002. I appear before you today in my capacity as Chair of the National Research Council's committee assessing the JDPO's Integrated Plan for a Next Generation Air Transportation System. The National Research Council is the operating arm of the National Academy of Sciences, National Academy of Engineering, and the Institute of Medicine of the National Academies, chartered by Congress in 1863 to advise the government on matters of science and technology.

In early 2004, NASA requested that the National Research Council (NRC) establish the Committee on Technology Pathways: Assessing the Integrated Plan for a Next Generation Air Transportation System under the auspices of the Aeronautics and Space Engineering Board. The committee was charged with assessing the first edition of the NGATS Integrated Plan, which the JPDO submitted to Congress in December 2004 (see <*www.jpdo.aero*>). The assessment committee met with staff from the JPDO and some of the integrated product teams (IPTs) that the JPDO has formed. Our committee's report was released in October of 2005.

Transforming the air transportation system is essential to meet the needs of the traveling public and other system users, to sustain the Nation's economic growth, and to help the United States maintain continued global aviation leadership. The *Federal Aviation Administration (FAA) Reauthorization Act of 2004,* which directs the Secretary of Transportation to establish the Next Generation Air Transportation System (NGATS) Joint Planning and Development Office (JPDO), creates the opportunity for all federal agencies with a stake in aviation to bring their resources to bear on this critical issue. Previous initiatives to modernize the U.S. aviation system have enjoyed limited success. The JPDO's multi-agency approach affords new possibilities for overcoming the substantial barriers inherent in the significant undertaking of developing and deploying an NGATS. The Secretary of Transportation and the FAA Administrator have both been supportive of the JPDO through public statements and through direct involvement in the Senior Policy Committee, which oversees the work of the JPDO and provides interdepartmental coordination.

The assessment committee considers the timely preparation of the first edition of the Integrated Plan to be a positive first step. Even so, substantial improvements in the Integrated Plan and the method by which it is being implemented are essential.

The next edition of the Integrated Plan should clearly state that increased demand is the key driver that mandates implementation of NGATS. The JPDO should redirect its efforts to focus on development of a systematic, risk-based approach for achieving the primary objective, which is to resolve demand issues and increase capacity, while also satisfying enabling, interrelated requirements for safety, security, environmental effects, consumer satisfaction, and industrial competitiveness. The Integrated Plan should make sure that secondary objectives, such as alignment of existing interagency efforts, do not overshadow the primary objective of meeting increased demand.

The JPDO should define operational concepts to satisfy future demand by phase of operation:

- airport operations
- terminal area operations
- en route and oceanic operations

Operational concepts for airport operations will be needed for flight operations during approach, landing, and takeoff; for ground operations; and for curb-to-gate processing of passengers within the terminal.

Operational concepts for terminal area operations will be needed for flight operations between the last en route waypoint and the initial approach waypoint at major airports. This includes multi-center operational concepts for terminal areas that are so close together that responsible traffic control centers should take a collaborative approach to traffic flow management.

Operational concepts for en route and oceanic operations will be needed for aircraft operating between the terminal areas at their points of origin and destination,

including aircraft operating in oceanic airspace. Operational concepts at this level should also encompass national traffic flow management.

Even though the current IPTs have multi-agency membership, they are functioning primarily as experts in specific disciplines rather than as cross-functional, integrated, multi-disciplinary teams organized to deliver specific products that will improve operational capabilities of the air transportation system. To better support the core goal of meeting increased demand in each phase of operation, the JPDO's IPT structure should be realigned and simplified. All of the current IPTs (except for the Master IPT) should be disbanded and replaced with three new IPTs, one for each of the above operational concepts. Safety, security, weather, and other elements of the existing IPTs should be embedded in each of the three new IPTs, as appropriate, and the JPDO should establish goals related to cost, schedule, and level of performance that can be quantified using appropriate figures of merit.

Adequate support for all core technologies and processes that will be included in NGATS is crucial to validate the Integrated Plan. In particular, the NASA administrator should continue—and the Senior Policy Committee and the JPDO should advocate for continuation of—research on core NGATS technologies and processes. Likewise, the JPDO itself must receive adequate resources. The members of the Senior Policy Committee should ensure that the federal agencies they direct or represent allocate funding and staff to (1) provide the JPDO with the resources it needs to define NGATS and draw up an appropriate implementation plan and (2) ensure departmental and agency research in civil aeronautics is consistent with plans developed by the JPDO and endorsed by the Senior Policy Committee to enable and implement new operational concepts.

The first edition of the Integrated Plan has little to say about implementation other than to acknowledge that the IPTs will need to address implementation and transition issues. Successful implementation of NGATS requires an Integrated Plan that does the following:

- Clearly addresses the needs of the traveling public, shippers, and other system users, which vary with fluctuations in the economy.
- Establishes a source of stable funding suitable for development, implementation, and operation of NGATS, including capital improvements.
- Proposes reforms in governance and operational management that assure accountability and limit the effect of traditional external influences. The interests of individual stakeholders should be balanced with the common good in a way that expedites the deployment of optimal technologies and procedures and achieves the primary goal of meeting increased demand.
- Defines an NGATS that efficiently interfaces with the rest of the global air transportation system.

The Secretary of Transportation, as Chair of the Senior Policy Committee, and the FAA administrator, as a member of the Senior Policy Committee, should help the JPDO accomplish each of the above goals by, for example, supporting jointly funded, collaborative research to define NGATS operational concepts suitable for global implementation. They should also lead the development of a proposal to adequately fund the development, implementation, and operation of NGATS.

The assessment committee's overall guidance is summarized in the following recommendation:

The Secretary of Transportation, the FAA Administrator, the rest of the Senior Policy Committee, and the JPDO should invigorate development, implementation, and operation of the Next Generation Air Transportation System, especially with regard to the development of core technologies and processes, as follows:

- Focus the work of the JPDO on development of a systematic, risk-based approach for achieving the primary objective, which is to resolve demand issues and increase capacity while also satisfying enabling, interrelated requirements for safety, security, environmental effects, consumer satisfaction, and industrial competitiveness.
- Restructure the JPDO as a product-driven organization with three coordinated operational concepts and three IPTs focused on (1) airport operations, (2) terminal area operations, and (3) en route and oceanic operations (plus the Master IPT for systems integration and oversight).
- Consistently provide the JPDO and its IPTs with strong, fully involved leadership and program management capabilities, along with more full-time staff.
- Draw up a plan to establish a viable source of stable funding and a governance structure suited to the Next Generation Air Transportation System.

- Undertake a more vigorous effort to collaborate with foreign governments and institutions, to include jointly funded, collaborative research to define operational concepts suitable for global implementation.

Thank you for the opportunity to testify. I would be happy to take any questions the Committee might have.

COMMITTEE ON TECHNOLOGY PATHWAYS: ASSESSING THE INTEGRATED PLAN FOR A NEXT GENERATION AIR TRANSPORTATION SYSTEM

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[1] Resigned May 7, 2005.

Assessing the Integrated Plan for a Next Generation Air Transportation System

March 29, 2006

Mr. S. Michael Hudson, Chair
Committee on Technology Pathways

Aeronautics and Space Engineering Board
National Research Council
The National Academies

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

JDPO Integrated Plan

- Tasks
  - Plan the development of an air transportation system capable of meeting the potential air traffic demand by 2025.
  - Oversee and coordinate the necessary research among federal and private industry.

- Assessment
  - Limited authority and fiscal resources.
  - Integrated Product Teams involve interested agencies and ensure responsibility for improvement of the system is with those with the authority and resources to make changes.
  - Strong, involved leadership is required from the Senior Policy Committee; **the Secretary of Transportation is ultimately responsible for success.**
  - Initial IPT structures address the complexity of the issues and involve stakeholders, but should focus on operational products that address demand.

Priorities

- Demand
  - Demand and the associated requirements to increase capacity are the primary issues.
  - **The Plan needs to prioritize demand above other objectives.**
- Operational Concepts
  - Airport Operations.
  - Terminal Area Operation.
  - En Route and Oceanic Operation.
- Global Collaboration
  - Vigorous U.S. leadership in implementing global collaboration is required to ensure competitiveness.

Technical and Programmatic Challenges

- Core Research
  - Automation.
  - Human factors.
- Resources
  - Adequate, stable funding is not available.
  - Public and private participation is necessary.
  - Departments involved must respect stability in their budgeting.
- Organization
  - Consolidate and align the ITPs with the three operational phases of air transportation.
  - Multi-agency membership is positive, but results in IPTs operating as experts in each discipline, instead of a cross-functional team.

BIOGRAPHY FOR S. MICHAEL HUDSON

Mike Hudson assumed the position of Vice Chairman, Rolls-Royce North America in early 2000 and continued in that role through his retirement in the spring of 2002. Prior to that he held the position of President, Chief Executive Officer of Rolls-Royce Allison following its acquisition by Rolls-Royce in 1995. He also served as Chief Operating Officer and Chief Financial Officer at various times during this period. Mr. Hudson was one of two managers who with Clayton Dublier acquired Allison Gas Turbine from General Motors Corporation. He has served on the management boards of several joint venture companies in which Rolls-Royce Allison has had interest. Mr. Hudson is a member of the Board of directors of the Indianapolis Water Company.

Mr. Hudson has served as Chief Engineer for advanced technology engines, Chief Engineer for small production engines, supervisor of design for the Model 250 engines, Chief of Preliminary Design and Chief Project Engineer in vehicular gas turbines during his tenure at Allison. Mr. Hudson joined Allison in 1968 as the project engineer for the ATEGG core engine demonstrator program.

A major re-engineering of the company was successfully completed including the implementation of the SAP ERP system during the period of his leadership. Also during this period the company executed the development and introduction into service of several models and series of military and commercial turbofan, turboprop and turboshaft engines as well as making significant technical advances in the area.

Following graduation from the University of Texas with a degree in mechanical engineering, Mr. Hudson was employed by Pratt & Whitney Aircraft from 1962 to 1968 working in aircraft engine design, installation and performance, engine development and demonstration, and industrial and marine engine application engineering.

PROFESSIONAL AND CIVIC ACTIVITIES

Mr. Hudson is a Fellow of the Society of Automotive Engineers and the Royal Aeronautical Society, an honorary Fellow of the American Helicopter Society and an Associate Fellow of the American Institute of Aeronautics and Astronautics.

In professional society work, Mr. Hudson has been a member of the American Institute of Aeronautics and Astronautics Propulsion Committee and the American Helicopter Society Propulsion Committee and has been Chairman of the American Helicopter Society Board of Directors. Mr. Hudson has been a member of the Board of Directors of the National Association of Manufacturers and of the Society of Automotive Engineers, and has served as Chairman of the SAE's Aerospace Council, been on their Aerospace Program Office Committee and their Finance Committee. He has received the SAE Franklin W. Kolk Air Transportation Progress Award and the Royal Aeronautical Society British Gold Metal and has been associated with five Collier Trophy winning programs. He has served on the Aerospace Industries Association Technical Council and chaired their Civil Aviation Division. Publications range from technical work on propulsion to defense procurement and business initiatives.

Mr. Hudson has served on Air Force and Department of Defense review groups including ad hoc committees to the Science Advisory Board, the Defense Science Board Task Force on Commercial Procurement, and the Industry Review Group of the Integrated High Performance Turbine Engine Technology Initiative.

For NASA, Mr. Hudson was a member of the Aeronautics Advisory Committee and the Subcommittee on Rotorcraft Technology and chaired the Propulsion Aeronautics Research and Technology Subcommittee. He also served on the National Research Council Committee on Strategic Assessment of the U.S. Aeronautics Program, the Committee on Aeronautics Research and Technology for Environmental Compatibly, the Committee on Aeronautics Research and Technology for Vision 2050 and the Committee on NASA's Revolutionize Aviation Strategic Plan and is a member of their Aeronautics and Space Engineering Board.

Mr. Hudson is on various local university and civic boards and has chaired or been a member of charitable fund raising activities. He has served as a Visiting Professor at Cranfield University in the United Kingdom and is a member of the Board of Trustees of Marian College.

Mr. HALL. Thank you very much, Mr. Hudson. At this time I recognize Dr. Gerald Dillingham, Director of Civil Aviation Issues, Government Accountability Office. And I will say at this time, since we are approaching the last witness, that I want to thank every one of you and we are aware of the fact that you are in the midst

of a study on the JPDO, and started sometime last fall and I appreciate the efforts that all of you put in on it. We have seen an early draft of it and it seems to be very thorough and I think—I want to thank you, Dr. Dillingham, and thank others. It seems like every one of you have had a little bit of push and a thrust in it. I do appreciate it and we recognize you, Dr. Dillingham, to close out the panel's——

STATEMENT OF DR. GERALD L. DILLINGHAM, DIRECTOR, PHYSICAL INFRASTRUCTURE ISSUES, GOVERNMENT ACCOUNTABILITY OFFICE

Dr. DILLINGHAM. Thank you, Chairman Hall, Mr. Udall, Mr. Ehlers, and Members of the Subcommittee. At your request, the GAO has been studying how the JPDO has organized itself and the planning activities that have been undertaken for the Next Generation Air Transportation System. You asked that we examine the status of the JPDO's activities in three areas. First, to what extent has the JPDO been successful in getting the partner agencies to work together and align their resources? Second, how is JPDO involving stakeholders in the planning process? And third, to what extent is the JPDO conducting the technical planning necessary to develop the NGATS? This afternoon my testimony will highlight some of our key preliminary findings and identify some potential challenges as the JPDO moves forward.

With regard to getting the partner agencies to work together and align resources, we found that the JPDO is employing several practices in this area that have been shown to be effective in facilitating collaboration among federal agencies. As you have already heard, the JPDO is leveraging resources by staffing its organization with employees of the partner agencies. JPDO has also reviewed the partner agencies' R&D programs to identify early opportunities to leverage ongoing or planned activities that could support NGATS. The office has also begun to work with OMB to develop a systematic way to consider NGATS as a program rather than disconnected line items in separate agency budget requests. By using these and other practices to promote collaboration among the agencies, we think that the JPDO has gotten off to a positive start in this area.

However, there are some potentially important challenges also in this area. For example, maintaining this collaboration over the long-term. This challenge may become a serious issue as the JPDO moves further along in its planning efforts, where it may require more staff time and other resources from the partner agencies. Another potential challenge for JPDO will be to obtain adequate resources in a timely fashion to be able to conduct the activities such as needed research and demonstration projects, to develop tools and to test concepts. We found, in past reviews of ATC modernization, that the lack of adequate funds being available in a timely fashion was an important contributing factor to some modernization projects being years behind and costing millions over budget.

Mr. Chairman, with regard to the Subcommittee's second area of concern, the actions that the JPDO has taken to ensure adequate involvement of the stakeholders in the planning process, we found that the JPDO has incorporated federal and non-federal stake-

holders throughout its organization. However, one of the most critical challenges in this area is that the current air traffic controllers are not participating in the JPDO. We found that when key stakeholders were not involved throughout the modernization process, it can be a major contributing factor to significant delays in implementing new technologies and billions of dollars in cost overruns.

Another potential challenge is convincing industry stakeholders that the government is fully committed to NGATS. There have been cases in the past where FAA has asked industry to equip for a new technology or procedure, but subsequently canceled the program or was significantly delayed in deploying the technology or deploying the necessary procedures. The financial condition of the aviation industry today does not leave much room for investments that do not yield a benefit for them in the short-term.

Mr. Chairman, I would like to turn now to the Subcommittee's final area of concern, which is the extent to which JPDO is conducting the technical planning needed to develop NGATS. We found that the JPDO is addressing the technical planning needed to develop NGATS by assembling a suite of models to analyze the interactions among system performance parameters, demand and economic factors. However, there is a critical gap in the technical planning area, that is, extending some of the human factors modeling that JPDO has begun with regard to air traffic controller workload, to look at how the shift in workload from air traffic controllers to pilots will affect pilot performance. Any shift in workload from air traffic controllers to pilots is a critical issue, because a key premise of the NGATS is that many functions that the air traffic controllers now conduct will be performed by pilots in the future. JPDO is also developing an enterprise architecture, or blueprint, for NGATS. We found that the JPDO is using a phased approach to develop the enterprise architecture. We think this is a reasonable approach and is similar to the build a little, test a little approach which we have advocated for FAA's current ATC modernization program.

Mr. Chairman, we believe that in the final analysis, the success of the JPDO and the broader NGATS is a shared responsibility of the JPDO partner agencies, industry and other stakeholders, as well as the Congress. These responsibilities are substantial, and failure to perform by any one of these stakeholders will significantly affect the JPDO's chances of planning for a system that will accommodate a threefold increase in airspace capacity by 2025. Thank you, Mr. Chairman. That concludes my statement.

[The prepared statement of Dr. Dillingham follows:]

PREPARED STATEMENT OF GERALD L. DILLINGHAM

Mr. Chairman and Members of the Subcommittee:

We appreciate the opportunity to participate in today's hearing to discuss the status of the Joint Planning and Development Office (JPDO) after its first two years of existence. The health of our nation's air transportation system is critical to our citizens and economy. However, the current approach to managing air transportation is becoming increasingly inefficient and operationally obsolete. In November 2002, the congressionally chartered Commission on the Future of the United States Aerospace Industry recommended transforming the U.S. air transportation system

as a national priority.[1] Transforming the system to accommodate what is expected to be three times the current amount of traffic by 2025, providing adequate security and environmental safeguards, and doing these things seamlessly while the current system continues to operate, will be an enormously complex undertaking.

In 2003, Congress passed the *Vision 100—Century of Aviation Reauthorization Act,* which created JPDO within the Federal Aviation Administration (FAA) to manage work related to the creation of a "next generation air transportation system" (NGATS). JPDO has responsibility for coordinating the research efforts of its partner agencies—the Departments of Transportation (DOT), Commerce (DOC), Defense (DOD), and Homeland Security (DHS); FAA; and the National Aeronautics and Space Administration (NASA). JPDO is also working with its final partner agency—the White House Office of Science and Technology Policy—to coordinate funding with the Office of Management and Budget. Additionally, JPDO has responsibility to consult with the public; to coordinate federal goals, priorities, and programs with those of aviation and aeronautical firms; and to ensure the participation of stakeholders from the private sector, including commercial and general aviation, labor, aviation research and development entities, and manufacturers. JPDO is jointly funded through FAA and NASA. The JPDO Director reports to the FAA Administrator and to the Chief Operating Officer of FAA's Air Traffic Organization.[2]

Vision 100 directed JPDO to develop an integrated plan for the NGATS and to include in the plan, among other things, a vision statement for an air transportation system that meets potential air traffic demand by 2025; a description of the demand and required performance characteristics of the future system; and a high-level, multi-agency roadmap and concept of operations for the future system. Key tenets of the plan are transitioning from the current largely ground-based navigation system to one that is more focused on aircraft and satellite-based navigation, and automating many of the routine air traffic control functions. In addition, the integrated plan discusses a strategy to harmonize the NGATS with equipage and operations around the world to enhance safety and efficiency on a global scale. As directed by *Vision 100,* the FAA Administrator provided this integrated plan to Congress in December 2004 and issued the first annual progress report earlier this month.

My statement today provides preliminary results from our ongoing study of the status of JPDO and focuses on three specific questions. (1) To what extent is JPDO facilitating the federal interagency collaboration and aligning the human and financial resources needed to define and perform the centralized planning function for the detailed implementation of the NGATS? (2) What actions or initiatives has JPDO implemented to ensure adequate involvement of stakeholders in the planning process? (3) To what extent is JPDO conducting the technical planning needed to develop the NGATS? My statement is based on our analysis of documents provided by JPDO and its partner agencies; the perspectives of agency officials and stakeholders with whom we have spoken; the results of a panel of experts that we convened earlier this month; and our review of relevant literature, including the integrated plan and the progress report. We also draw upon our prior work on FAA's national airspace system modernization program, which we have listed as a high-risk program since 1995. To assess JPDO's prospects for facilitating collaboration among its partner agencies, we compared its practices to those that we have found to be effective in facilitating other federal interagency collaborative efforts.[3] We also reviewed the National Research Council's 2005 report on JPDO, which provided a technical assessment of the research, development, and technology components of JPDO's integrated plan.[4] In addition, we reviewed relevant documents and interviewed officials and stakeholders regarding Europe's effort to harmonize and modernize its air traffic management system. Later this year, we expect to issue a detailed report that will provide our assessment of the status of JPDO's efforts as it works to develop the NGATS. We are performing our work in accordance with generally accepted government auditing standards.

In summary:

- JPDO is implementing a number of practices that our work has shown facilitates collaboration among federal agencies, but faces a challenge in maintaining this collaboration over the long-term. These practices include defining and

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[1] Commission on the Future of the United States Aerospace Industry, *Final Report* (Nov. 2002).

[2] The Air Traffic Organization is FAA's business unit that is responsible for operating, maintaining, and modernizing the Nation's current air traffic control system.

[3] GAO, *Results-Oriented Government: Practices That Can Help Enhance and Sustain Collaboration Among Federal Agencies,* GAO–06–15 (Washington, D.C.: Oct. 21, 2005).

[4] National Research Council, *Technology Pathways: Assessing the Integrated Plan for a Next Generation Air Transportation System* (Washington, D.C.: 2005).

articulating a common outcome, establishing mutually reinforcing or joint strategies to achieve that outcome, and identifying and addressing needs by leveraging resources among partner agencies. JPDO's legislation established a common outcome—a transformed national airspace system by 2025—that JPDO expanded on in its integrated plan, which establishes an overarching framework and goals for its activities. The plan also laid out eight joint strategies for partner agencies to use as they help develop the NGATS. Additionally, JPDO is leveraging partner agency resources by staffing its organization with employees of the partner agencies, many of whom work for JPDO as a collateral duty. JPDO has also reviewed these agencies' research and development programs to identify work that could support the NGATS. By using these practices for facilitating collaboration, JPDO has gotten off to a positive start. However, because JPDO is fundamentally a planning and coordinating body, it does not have authority over the partner agencies' human and financial resources that it needs to continue performing the centralized, interagency planning function for detailed implementation of the NGATS. Consequently, leveraging resources will continue to be critical to JPDO's success, particularly in future years as partner agencies begin to implement projects on a larger scale. JPDO was successful in prompting FAA to request funding to accelerate system development for two key NGATS systems in its fiscal year 2007 budget request. However, JPDO officials told us that, while FAA did receive an increase, it did not receive the full amount requested in the budget formulation documents submitted to the Office of Management and Budget. Our work on FAA's current air traffic control modernization program has shown that receiving fewer resources than planned was a contributing factor in schedule delays and subsequent cost increases. To its credit, JPDO is working with its partner agencies to align their fiscal year 2008 budget requests to support the NGATS. JPDO has also opened a dialogue with the Office of Management and Budget to develop a systematic means of reviewing partner agency budget requests so that NGATS-related programs can be easily identified.

- JPDO has incorporated representatives from federal and non-federal stakeholders throughout its organization. Federal stakeholders from the partner agencies work with JPDO throughout multiple levels of the organization. The NGATS Institute was created as the mechanism for involving non-federal stakeholders and has obtained their participation and assigned them to work with JPDO's federal stakeholders. The NGATS Institute Management Council, composed of top officials and representatives from the aviation community, provides a means for advancing consensus positions on critical NGATS issues. However, a critical stakeholder in the Nation's air traffic control system has yet to become an active participant in this forum. Air traffic controllers, who work in the current system and will play a key role in the NGATS, have not been involved in JPDO's efforts. In the past, FAA's failure to adequately involve air traffic controllers in its acquisition of new technologies, such as the Standard Terminal Automation Replacement System—a workstation for air traffic controllers—contributed to costly rework and schedule delays. A challenge for JPDO could be sustaining non-federal stakeholders' participation in an effort where tangible benefits may not be realized until several years in the future. JPDO also faces the challenge of convincing non-federal stakeholders that the government is financially committed to the NGATS. Additionally, JPDO could face a challenge in resolving the divergent perspectives that are represented by its non-federal stakeholders.
- JPDO is using an iterative process to address the technical planning needed to develop the NGATS that appears reasonable in light of the system's complexity. The office has assembled a suite of models to iteratively analyze and understand the interactions among system performance parameters, demand, and economic factors, and has developed an enterprise architecture, or "blueprint," for the NGATS. JPDO is testing the adequacy of its suite of models, publishing the results, and seeking peer review opportunities. However, these modeling efforts, including those addressing human factors, are currently in the early stages, and more time and field testing will be needed to increase confidence that the final range of solutions for the NGATS is based on realistic assumptions. With respect to enterprise architecture, JPDO has established the organizational structure for enterprise architecture development—an important first step—and anticipates having an initial version of the architecture by the end of fiscal year 2006. Recognizing that further work will be required, JPDO is using a multi-year phased planning approach in which the

enterprise architecture will be continuously refined. This "build a little, test a little" approach is similar to a process that we have previously advocated for FAA's major system acquisition programs.

Background

FAA, with research assistance from NASA, has had the primary responsibility for planning and implementing national airspace system modernization since these efforts began more than 20 years ago. Recently, FAA placed the modernization program under a new Air Traffic Organization, headed by a Chief Operating Officer. JPDO's approach differs from FAA's past modernization efforts in that its scope is "curb-to-curb," encompassing in-terminal passenger and baggage security screening and environmental issues. Additionally, JPDO's approach will require unprecedented consensus and cooperation among many stakeholders—federal and non-federal—about necessary system capabilities, equipment, procedures, and regulations. JPDO seeks to leverage the resources of NASA and the Departments of Transportation, Commerce, Defense, and Homeland Security, each of which has expertise and technology that will play a part in the NGATS. For example, the Department of Defense has deployed "network centric" systems, originally developed for the battlefield, which are being considered as a framework to provide all users of the national airspace system—FAA and the Departments of Defense and Homeland Security—with a common view of that system.

Concurrent with JPDO's efforts, the European Commission[5] is conducting a project to harmonize and modernize the pan-European air traffic management system. Known as the Single European Sky Air Traffic Management Research Programme (SESAR), the project is being managed by the Air Traffic Alliance, an industry partnership that was awarded the management contract by the European Organisation for the Safety of Air Navigation (Eurocontrol).[6] Eurocontrol develops, coordinates, and plans for the implementation of pan-European air traffic management strategies. While the U.S. and European efforts are both directed at modernization, Europe faces the additional challenge of harmonizing its air traffic control system—currently operated through a patchwork of national air navigation service providers. The work of the SESAR effort, which was scheduled to officially start this month, is being done by a 30-member consortium of airlines, air navigation service providers, airports, manufacturers, and others. The consortium is receiving 60 million euros ($73 million)[7] to conduct a two-year definition phase and produce a master plan for SESAR. The next steps following the definition phase, from 2008 to 2013, are currently under discussion. One proposal would develop the technologies for the new system and would be funded annually at 300 million euros ($363 million) per year, with equal contributions being provided by the European Commission, Eurocontrol, and other parties.

JPDO Is Engaging in Effective Practices for Interagency Collaboration, But Faces Challenges in Leveraging Resources and Defining Responsibilities

Our work to date shows that JPDO has engaged in practices to facilitate federal interagency collaboration, including defining and articulating a common outcome; establishing mutually reinforcing or joint strategies; and beginning to leverage the partner agency resources needed to perform the centralized, interagency planning function for the detailed implementation of the NGATS. However, JPDO faces a challenge in leveraging resources because it is fundamentally a planning and coordinating body that lacks authority over the key human and financial resources needed to continue developing plans and system requirements for the NGATS. Additionally, JPDO faces the challenge of clearly defining roles and responsibilities among its partner agencies. Our work has shown that collaborating agencies should work together to define and agree on their respective roles and responsibilities, including how the collaborative effort will be led. To its credit, JPDO is taking some actions to mitigate these challenges.

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[5] The European Commission is a politically independent institution that prepares and implements legislative instruments.

[6] Eurocontrol is an autonomous organization established in 1963 with the intention of creating a single upper airspace.

[7] A portion of this funding is in-kind services from Eurocontrol. To convert euros to U.S. dollars, we used 1.2098, the foreign exchange rate for Tuesday, March 21, 2006, as published in *The Washington Post*.

JPDO Has Articulated a Common Outcome, Established Mutually Reinforcing or Joint Strategies, and Begun to Leverage Resources

JPDO's integrated plan provides a vision statement that elaborates on the broadly stated common outcome set forth by the *Vision 100* legislation—an air transportation system that meets potential air traffic demand by 2025. In working together to develop JPDO's integrated plan, the partner agencies agreed upon a broad statement of future system goals, performance characteristics, and operational concepts. Our research shows that, for interagency collaborative efforts to overcome significant differences in agency missions, cultures, and established ways of doing business, the agencies must have a clear and compelling rationale to work together. JPDO's partner agencies agreed to a vision statement: a transformed air transportation system that provides services tailored to individual customer needs, allows all communities to participate in the global economy, and seamlessly integrates civil and military operations.

The plan also provides eight strategies—again developed by the partner agencies—that broadly address the goals and objectives for the NGATS. JPDO has formed eight integrated product teams (IPTs), one for each strategy. Our work has shown that mutually reinforcing or joint strategies help in aligning the partner agencies' activities, core processes, and resources to accomplish the common outcome. In addition to jointly identifying the strategies for the NGATS, the various partner agencies have taken the lead on specific strategies. (See Table 1.) JPDO is currently reevaluating whether all of these IPTs should be expected to create products. For example, the IPT that is addressing the global inter-operability strategy might be more likely to have cross-cutting influence over the other seven IPTs, rather than developing a product of its own, according to JPDO officials.

Table 1. JPDO's Strategies and Responsible Agencies

Strategy	Lead agency
Develop airport infrastructure to meet future demand	Federal Aviation Administration
Establish an effective security system without limiting mobility or civil liberties	Department of Homeland Security
Establish an agile air traffic system that quickly responds to shifts in demand	National Aeronautics and Space Administration
Establish shared situational awareness—where all users share the same information	Department of Defense
Establish a comprehensive and proactive approach to safety	Federal Aviation Administration
Develop environmental protection that allows sustained aviation growth	Federal Aviation Administration
Develop a systemwide capability to reduce weather impacts	Department of Commerce
Harmonize equipage and operations globally	Federal Aviation Administration

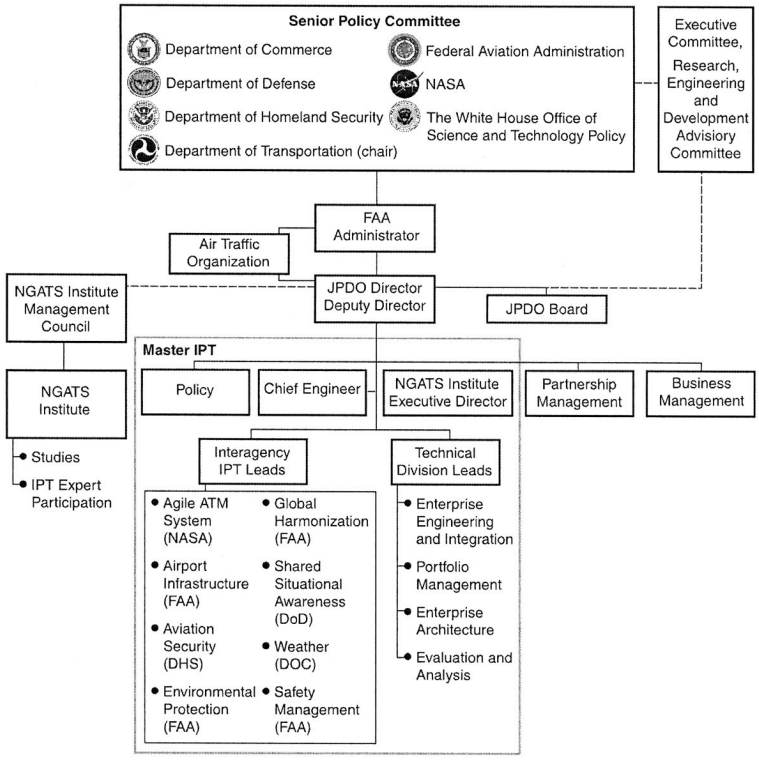
Source: GAO presentation of JPDO data.

The National Research Council, in its recent study of JPDO, noted the IPT structure is oriented by discipline, which the Council believes works against a product orientation. The Council recommended that JPDO reorganize into three IPTs that parallel the way FAA currently organizes its operations—airport, terminal, and en route/oceanic. JPDO officials do not agree with this recommendation. They told us that the existing airspace segmentation by phase of flight—airport, terminal, and en route—creates inefficiencies. As aircraft transition from one phase of flight to the next, they encounter a "speed bump." For example, operations are slowed as en route air traffic controllers transfer responsibility for aircraft to terminal controllers. This segmentation is not part of JPDO's vision for the NGATS. In our view, if JPDO's IPT structure begins to show evidence that it is hindering rather than promoting progress toward achieving NGATS goals, JPDO might look again at the Council's recommendations to determine whether a different structure or fewer IPTs would help it achieve its goals. In the end, the progress and outcomes achieved by

the structure are as important, if not more important, than the organizational model selected.

JPDO has begun leveraging the resources of its partner agencies, which is another practice that we have found helps facilitate interagency collaboration. Our research shows that collaborating agencies should identify the human, information technology, physical, and financial resources needed to initiate or sustain their collaborative effort. To leverage human resources, JPDO has staffed its organization with partner-agency employees, many of whom work for JPDO as a collateral duty. The JPDO board, which provides coordination between partner agencies and JPDO, is composed of key executives of the partner agencies who can facilitate bringing agency resources to bear on NGATS development. JPDO's eight IPTs, which are developing the plans and requirements for the NGATS, include staff from the partner agencies. Additionally, *Vision 100* created the Next Generation Air Transportation Senior Policy Committee, composed of partner agency senior executives, to provide ongoing policy review and identify resource needs from the partner agencies. (See Fig. 1.)

Figure 1: JPDO Organization Chart



Source: JPDO.

To further begin leveraging resources, during the past year JPDO conducted an interagency program review of its partner agencies' research and development programs to identify the work that could support the NGATS, as well as identify areas for more effective interagency collaboration. Through this process, JPDO identified early opportunities that could be pursued during fiscal year 2007 to produce tangible results for the NGATS. For example, JPDO noted that FAA had amassed considerable technical expertise in the standards, protocols, and near-term air traffic applications for Automatic Dependent Surveillance-Broadcast (ADS–B). ADS–B is a

technology through which an aircraft broadcasts information on its position to ground-based transceivers, rather than having its position detected by ground-based radars. JPDO envisions FAA beginning to purchase ADS–B transceivers, decommission obsolete ground-based radars, and develop air traffic procedures that would permit ADS–B-equipped aircraft to obtain near-term operational benefits such as routings that save fuel.

JPDO Faces Challenges in Continuing to Leverage Resources and Defining Roles and Responsibilities

Although JPDO's legislation, integrated plan, and established governance structure provide the framework for institutionalizing collaboration among multiple federal agencies, JPDO is fundamentally a planning and coordinating body that lacks authority over the key human and financial resources needed to continue developing plans and system requirements for the NGATS. Consequently, leveraging resources on a continuing basis will be critical to JPDO's success. Our research has also shown that agreement on roles and responsibilities facilitates interagency collaboration. However, in JPDO's situation, some important roles and responsibilities have not yet been clearly defined.

The challenge of leveraging resources will likely intensify beginning in 2008, when JPDO expects a significant increase in the workload of its IPTs. JPDO anticipates needing more resources for the IPTs to, among other things, plan demonstrations of potential technologies to illustrate some of the early benefits that could be achieved from the transformation to the NGATS. JPDO officials told us that, although the partner agencies have not yet expressed concerns over the time that their employees spend on JPDO work, it remains to be seen whether partner agencies are willing to allow their staff to devote larger portions of their time to JPDO as the office develops more detailed plans and requirements for the NGATS. Partner agencies have a variety of missions and priorities other than supporting the NGATS. Some partner agency employees, including some IPT directors, have been told by their partner agencies that their work for JDPO is approved so long as it does not interfere with their regular assigned duties. Such resource issues would ultimately go to the Senior Policy Committee for resolution. However, the role of the committee's members, as stated in *Vision 100,* is only to make recommendations to their respective agencies for the required resources.

The challenge of leveraging financial resources has already manifested itself. As JPDO requested, FAA included in its fiscal year 2007 budget request to the Office of Management and Budget funding to accelerate systems development of ADS–B and System Wide Information Management (SWIM),[8] which are two key systems identified for the NGATS. However, JPDO officials told us that, while FAA did receive an increase, it did not receive the full amount requested in the budget formulation documents submitted to the Office of Management and Budget.[9] Our past work on FAA's national airspace modernization program has shown that, among other factors, receiving fewer resources than planned contributed to delays in implementing technologies and significant cost increases. For example, reduced funding was one factor that caused FAA to reduce the initial deployment of its ASR–11 digital radar system from 111 systems to 66 systems, and defer decisions on further deployment pending additional study. In the meantime, FAA will have to continue to maintain the aging analog radars that the new system was intended to replace.

JPDO also faces the challenge of clearly defining roles and responsibilities among its partner agencies. Our work has shown that collaborating agencies should work together to define and agree on the respective roles and responsibilities, including how the collaborative effort will be led. In JPDO's case, there is no formalized long-term agreement on the partner agencies' roles and responsibilities in creating the NGATS. According to JPDO officials, a memorandum of understanding that would define partner agency relationships was being developed as of August 2005, but has not yet been completed.

Defining roles and responsibilities is particularly important between JPDO and FAA's Air Traffic Organization, since both organizations have responsibilities related to planning national airspace system modernization. JPDO's planning must build upon the Air Traffic Organization's existing modernization program, while the

[8] SWIM would support the transition to network-centric operations by providing the infrastructure and associated policies and standards to enable information sharing among all authorized users, such as the airlines, other government agencies, and the military.

[9] FAA's fiscal year 2007 budget request for research and development includes about $18 million for JPDO, which is supplemented by matching funds from NASA. NASA has committed to continuing this match in the future, according to a JPDO official. JPDO uses these funds to conduct planning and studies. Outyear funding plans for JPDO show a slight decline through fiscal year 2010. *Vision 100* authorized $50 million annually for seven years for JPDO.

Air Traffic Organization must ensure that its ongoing modernization efforts are consistent with JPDO's plans. JPDO's former director served concurrently as the Air Traffic Organization's Vice President for Operations Planning, which helped with coordination between the two organizations. However, FAA now plans to establish separate positions for the JPDO Director and the Air Traffic Organization Vice President for Operations Planning. Doing so increases the importance of having a clearly defined relationship between these organizations.

Ultimate decision-making authority is another role and responsibility that has not been clearly defined. According to JPDO, decisions are the collective responsibility of the government agencies. The Senior Policy Committee makes decisions through consensus of the members. If there are any issues that the committee cannot resolve among themselves, JPDO officials expect that the Secretary of Transportation would elevate these issues to the appropriate White House-level policy council, such as the Domestic Policy Council. Although JPDO strives to make decisions and resolve disputes through its collaborative bodies, its experience thus far is limited. It is not clear whether this process will be effective as the NGATS planning and implementation effort moves forward. As part of our ongoing work, we will further explore the decision-making and dispute resolution mechanisms within JPDO.

To its credit, JPDO, in concert with the Air Traffic Organization, has begun to address these challenges. To assist with leveraging resources, JPDO has issued guidance to its partner agencies identifying areas that JPDO would like to see emphasized in their fiscal year 2008 budget requests. The Air Traffic Organization, in recognition of the need to align its plans with the 20-year planning horizon of JPDO, has extended its planning horizon. Finally, JPDO is working with the Office of Management and Budget to develop a systematic means of reviewing partner agency budget requests so that the NGATS-related funding in each budget request is easily identified. Such a process would help the Office of Management and Budget consider NGATS as a unified program rather than as disconnected line items across partner agency budget requests. To better define roles and responsibilities, JPDO planned to transmit the proposed memorandum of understanding to the JPDO board this month.

JPDO Established Mechanisms to Involve Stakeholders But Faces Challenges

As required by *Vision 100,* JPDO developed and implemented mechanisms for soliciting the expertise and views of federal and non-federal stakeholders as it plans the NGATS. Although JPDO has obtained the involvement of over 180 participants from over 70 organizations for the IPTs, the current air traffic controllers—who will play a key role in the NGATS—have not been involved in JPDO's efforts. In addition, JPDO may face challenges in sustaining stakeholder involvement over the long-term.

JPDO Is Involving Federal and Non-federal Stakeholders

JPDO has structured itself in a way that involves federal and non-federal stakeholders throughout its organization. *Vision 100* directed JPDO to involve federal and non-federal stakeholders as it fulfills its mission. Our work shows that involving stakeholders can, among other things, increase their support for the collaborative effort. Federal stakeholders from the partner agencies participate with JPDO through the Senior Policy Committee, the JPDO board, and the IPTs. To incorporate the expertise and views of stakeholders in private industry, State and local governments, and academia, the NGATS Institute (the Institute) was created by an agreement between the National Center for Advanced Technologies and FAA.[10]

Within the Institute, the Institute Management Council (the Council), composed of top officials and representatives from the aviation community, oversees the policy and recommendations of the Institute. The Council provides a means for advancing consensus positions on critical NGATS issues. It is co-chaired by the president of the Air Transport Association, which represents commercial airlines, and the president of the Air Line Pilots Association, which represents airline pilots. The Institute has solicited participation from non-federal stakeholders and assigned them to each IPT. Additionally, the Institute planned to hold its first public meeting on March 28, 2006, to solicit information from other interested stakeholders who are not involved in the Council or the IPTs.

JPDO officials are generally pleased with the quality of stakeholder participation. Through the Institute, JPDO obtained the participation of over 180 stakeholders from over 70 organizations for the IPTs. The Institute received positive feedback

[10] The National Center for Advanced Technologies is a nonprofit unit within the Aerospace Industries Association.

from IPT directors on the skills, insight, and expertise of the private sector volunteers. Additionally, an official affiliated with the Institute told us that the collective quality and breadth of expertise of applicants for the IPTs has exceeded expectations.

However, JPDO has experienced difficulties with soliciting the participation of current air traffic controllers, who will play a key role in the NGATS. The current air traffic control system is based primarily on the premise that air traffic controllers direct pilots to maintain safe separation between aircraft. In the NGATS, this premise could change and, accordingly, JPDO has recognized the need to conduct human factors research on such issues, including how tasks should be allocated between humans and automated systems, and how the existing allocation of responsibilities between pilots and air traffic controllers might change. JPDO is tapping the expertise of former air traffic controllers, but current air traffic controllers are not yet involved with JPDO.

Specifically, the National Air Traffic Controllers Association (NATCA)—the labor union that represents air traffic controllers—is not participating in the development of the NGATS. In July 2005, FAA terminated the controller liaison program, wherein active controllers were assigned to, among other things, provide input on national airspace modernization projects. At that time, the union disengaged from participating on all FAA workgroups and technological projects, including JPDO. Although the Institute Management Council includes a seat for the union, an official of that union told us that the union's head had been unable to attend the Council's meetings. According to JPDO officials, the Council has left a seat open in hopes that the controllers will participate in the NGATS effort at the end of the contract negotiations between FAA and NATCA.

The lack of current air traffic controllers' participation could result in future problems. The input of current air traffic controllers who have recent experience controlling aircraft is important in considering human factors and safety issues. Our work on FAA's current national airspace modernization program has shown that early and continuing stakeholder input is important, particularly concerning human factors, in avoiding costly rework and schedule delays late in system development efforts. For example, as FAA procured new air traffic controller workstations (known as Standard Terminal Automation Replacement Systems (STARS)), not adequately including stakeholders during the development phase contributed to unplanned work which, in turn, contributed to cost growth, schedule delays, and eventually a reduction in the number of systems to be deployed.[11]

Another method for stakeholder involvement is through JPDO's facilitation of technology transfer in its requests for studies to be contracted out through the Institute. For example, at JPDO's request, the Institute plans to analyze trade-offs between potential technologies to narrow the range of options that are most critical for the NGATS. JPDO has sent to the Institute its first request for studies, including an analysis of satellite navigation backup technology.

The Institute also creates industry-government partnerships through advanced-technology demonstrations. These demonstrations provide a mechanism for collaboratively testing operational concepts, refining requirements, and sharing technology between the public and private sectors. To date, two demonstration projects have been conducted by JPDO partner agencies, including demonstrations on the Small Aircraft Transportation System and Network Enabled Operations.

JPDO Faces Challenges in Maintaining Non-federal Stakeholder Support Over the Long-Term

Although JPDO has developed the mechanisms for involving stakeholders and brought stakeholders into the process, JPDO faces challenges in sustaining non-federal stakeholder participation over the long-term. Much as with the federal partner agencies, JPDO has no direct authority over the human and financial resources of its non-federal stakeholders. To date, these stakeholders' investment in the NGATS effort has been through their *pro bono* participation on the IPTs and the Institute Management Council. The non-federal stakeholders' participation varies from approximately 10 to 25 percent of their time per week on the IPTs and involves approximately one meeting per month for members of the Council. The challenge for JPDO is to maintain the interest and enthusiasm of these non-federal stakeholders, who will have to juggle their own multiple priorities and resource demands in order to maintain this level of participation, when some tangible benefits may not be realized for several years. For example, stakeholder support will be important for pro-

[11] GAO, *National Airspace System: Transformation will Require Cultural Change, Balanced Funding Priorities, and Use of All Available Management Tools,* GAO–06–154 (Washington, D.C.: Oct. 14, 2005).

grams such as SWIM, which is a necessary prerequisite to future benefits, but may not produce tangible benefits in the near-term.

Rather than obtaining voluntary, *pro bono* participation from non-federal stakeholders, several members of our expert panel suggested JPDO should outsource the NGATS planning efforts, as Europe has done. As previously noted, the European SESAR effort is led by an industry consortium under a contract with Eurocontrol. The contract calls for the consortium to deliver a master plan at the end of a two-year definition phase. JPDO officials told us that they considered various ways to structure their work, such as having the government formulate plans with industry comment, or having industry formulate plans and provide them to the government. JPDO settled on the existing model, which is a hybrid that involves initial government work with close industry participation. Because of the different circumstances surrounding the U.S. and European approaches (such as the European need to harmonize various national systems), we have not taken a position on which approach might be more effective.

In the wake of past national airspace modernization efforts, JPDO also faces the challenge of convincing non-federal stakeholders that the government is financially committed to the NGATS. While FAA's major air traffic control acquisitions programs are currently on track, earlier attempts at modernizing the national airspace system encountered many difficulties. In one instance, for example, FAA developed a controller-pilot data link communications system that transmitted scripted e-mail-like messages between controllers and pilots. One airline equipped its aircraft with this new technology, but because of funding cuts, FAA ended up canceling the program.[12] In a similar vein, we have reported that some aviation stakeholders expressed concern that FAA may not follow through with its airspace redesign efforts and are hesitant to invest in equipment unless they are sure that FAA's efforts will continue.[13] One expert with whom we spoke suggested that a way to mitigate this issue would be for the government to make an initial investment in a specific technology before requesting that airlines or other industry stakeholders purchase equipment.

Finally, JPDO could face a challenge in resolving the potentially divergent perspectives that are represented by its non-federal stakeholders. The range of non-federal interests that JPDO has solicited for this effort is broad and varied, and potentially conflicting (for example, the interests of commercial airlines versus the interests of general aviation aircraft owners and pilots). While the intent is to ensure that all stakeholders are given the opportunity to participate in developing the NGATS, dissension among these stakeholders is nevertheless possible. A large portion of the non-federal stakeholder participation is through the IPTs. JPDO officials told us that they expect IPT directors to resolve potential disputes among stakeholders and obtain a "convergence of opinion," which is defined by JPDO as working toward as close to a single position as possible while recognizing that the IPT director might need to make a final decision. JPDO officials told us that depending on the issue, the IPT director may elect to elevate the different views to the collection of IPT directors and senior JPDO officials for resolution. In such a situation, JPDO will be challenged to settle the dispute without alienating those non-federal stakeholders who might believe themselves to be adversely affected by the decision.

JPDO Is Using an Iterative Technical Planning Process

JPDO is using an iterative technical planning process that appears to be reasonable in light of the complexity of the NGATS. The planning process includes conducting modeling—a technique that mathematically represents the NGATS' system performance parameters, demand, and economic factors—as well as developing an enterprise architecture—a blueprint to guide NGATS development.

JPDO Has Begun to Use System Performance Modeling

JPDO has formed an Evaluation and Analysis Division (EAD), composed of FAA and NASA employees, and contractors, to assemble a suite of models that mathematically represent the interactions among system performance parameters, demand, and economic factors for the NGATS. These models iteratively test the relationships and interactions among factors based on a set of assumptions. For example, using models based on broad assumptions concerning fleet mix and passenger and flight demand, EAD has evaluated how the current air transportation system and proposed NGATS alternatives react. EAD has also used modeling to determine

[12] JPDO noted that FAA used this technology to conduct an operational data link demonstration that will provide valuable information for developing future requirements and reducing development and implementation risks.

[13] GAO–06–154.

whether current airport capacity is sufficient to support a tripling of air traffic. The modeling results will help JPDO further refine its plans for the NGATS, leading to additional modeling that uses more precisely defined assumptions, all the while narrowing the range of potential solutions. In addition, EAD is modeling costs and benefits of proposed NGATS solutions, as well as interactions among system performance parameters, demand, and economic factors, to demonstrate to JPDO management and the Office of Management and Budget that the proposed solutions are a cost-effective way to meet strategic goals and objectives.

Rather than creating its own models, EAD is assembling a suite of existing models from FAA, other agencies, and contractors. To assess the adequacy of these models, EAD has compared the results obtained from them to known previous conditions. For example, to assess how accurately a model reflects the impact of adverse weather on airport capacity, EAD has compared the model's results to what actually happened in a previous bad-weather event. In this case, the model proved to be accurate, thereby validating its further use.

EAD recognizes the importance of human factors in designing the NGATS, but has just begun studying this issue. Specifically, EAD has used modeling to study how possible changes in the duties of key individuals, such as air traffic controllers, could affect the workload and performance of others, such as airport ground personnel. NGATS could shift some tasks now done by air traffic controllers to pilots. However, EAD has not yet begun to model the effect of this shift on pilot performance because, according to an EAD official, a suitable model has not yet been incorporated into the modeling tool suite. According to EAD, addressing this issue is difficult because data on pilot behavior are not readily available to use in creating such models. Furthermore, EAD has not studied the training implications of various NGATS-proposed solutions because further definition of the concept of operations for these solutions has not been completed. As the concept of operations matures, it will be important for air traffic controllers and other affected stakeholders to provide their perspectives on these modeling efforts.

EAD plans to use outside experts to review the adequacy of its work. EAD will continue to publish results of its work in peer-reviewed journals. EAD officials said they are also exploring the possibility of pursuing a peer review relationship with SESAR officials. So far, however, EAD's modeling efforts are in the early stages and more time will be needed to conduct additional modeling and field testing to increase confidence that the final range of solutions for the NGATS is based on realistic assumptions.

JPDO Has Taken the First Steps Toward Developing an Enterprise Architecture

An enterprise architecture is a tool, or blueprint, for understanding and planning complex systems. It can facilitate NGATS planning by providing a strategic and integrated approach to decision-making. For example, enterprise architecture can help planners decide between various scenarios that involve flight takeoff, flight landing, and en route flight in bad weather. The NGATS enterprise architecture will provide the means for coordinating among the partner agencies and private sector manufacturers, aligning relevant research and development activities, and integrating equipment. The enterprise architecture will describe the current national airspace system, the NGATS, and the sequence of steps needed to transition between them.

JPDO has taken the initial steps towards developing an enterprise architecture and plans to have an early version by the end of fiscal year 2006. The office has established and filled a chief architect position and established an NGATS Architecture Council composed of representatives from each partner agency's chief architect office. This provides the organizational structure and oversight needed to develop an enterprise architecture. While this is an important first step and consistent with effective practices that we have identified in enterprise architecture development, JPDO's enterprise architecture development is currently a work in progress. JPDO is working toward completing two tasks that we have also identified as effective practices. First, JPDO is planning to use the Federal Enterprise Architecture Security and Privacy Profile, currently under development by the Federal Chief Information Officer Council, to help ensure effective integration of security and privacy requirements across NGATS enterprise architecture. Second, JPDO is developing metrics that are to be compliant with guidance from us and the Office of Management and Budget to measure the enterprise architecture's progress in development and effectiveness-in-use by the end of fiscal year 2006. JPDO recognizes that the development of the NGATS architecture will be a multi-year process that will involve a series of interim architectures.

JPDO's phased "build a little, test a little" approach for developing and refining its enterprise architecture is similar to a process that we have advocated for FAA's

major system-acquisition programs. After completing the initial version of its enterprise architecture, JPDO plans to undertake a comprehensive assessment to determine if additional efforts are necessary to improve the architecture and address any gaps that may have been identified. In addition, this phased development process will allow JPDO to incorporate evolving market forces and technologies in its architecture, and thus, to better manage change.

Concluding Observations

In closing, Mr. Chairman, ultimate responsibility for the success of JPDO and the broader NGATS effort is shared among JPDO and its partner agencies, non-federal stakeholders, and the Congress. JPDO and its partner agencies have responsibility to develop a plan, test technologies through demonstrations, and implement technologies to transform the current national airspace system in a timely and cost-efficient manner. Non-federal stakeholders, including industry representatives, state and local government officials, and members of academia, must actively participate in developing the plan. Some of these stakeholders—such as commercial airlines and general aviation operators—will have to follow through by equipping their aircraft to realize the benefits of the NGATS. Finally, the success of the NGATS will undoubtedly require support from Congress to obtain the resources and authority necessary to complete the planning and testing stage, acquire the necessary technologies, and develop procedures. Consequently, Congress will face difficult decisions on how to prioritize funding to support the NGATS with other national priorities. These responsibilities are substantial, but failure in any one of these areas will significantly affect JPDO's chances of achieving a three-fold increase in airspace capacity by 2025.

This concludes my statement. I would be pleased to respond to any questions that you or other Members of the Subcommittee may have at this time.

BIOGRAPHY FOR GERALD L. DILLINGHAM

Dr. Dillingham is currently serving as the Director of Civil Aviation Issues for the U.S. Government Accountability Office (GAO) in Washington, D.C. The GAO is the investigative and research arm of the U.S. Congress. He is responsible for directing program evaluations and policy analyses related to all aspects of civilian aviation, including safety, finance, environment, air traffic control, airport development and international aviation issues.

Dr. Dillingham received his Master's and Doctorate degrees from the University of Chicago and was a postdoctoral scholar at the University of California-Los Angeles. Recognized as a national authority on aviation issues, he has testified as an expert witness before numerous committees of the U.S. Congress and served on the National Commission on Terrorist Attacks Upon the United States (9/11 Commission)—Aviation and Transportation Security Team.

DISCUSSION

Mr. HALL. Thank you, Dr. Dillingham. That concludes the testimony of the witnesses and at this time we will tell you that your entire statement will go in the record, unless there is objection. Is there objection? The Chair hears none. They go into the record and we thank you for that.

LEADERSHIP OF NGATS

I will kick it off by asking a couple of questions here, and I guess this question would be to Dr. Porter or to either Mr. Shane or Mr. Pearce or maybe the three of you want to cooperate on it. Who would be ultimately responsible for ensuring that the research for NGATS actually gets accomplished? With all these parties playing there, who is to take that lead?

Mr. PEARCE. Well, the responsibility for the research really depends on the area in which the research has to occur. So in many cases, for example, in the air traffic management area, we are depending on NASA to perform that research in cooperation with the

FAA and others. I think the real question comes in is with respect to the transfer of that technology into operation. That is where it gets tricky. The whole idea behind the JPDO and NGATS is to get everybody on the same plan. Where technology transfer generally works is when everybody is working to the same plan, there is a—and there is a resource plan for that handoff and the technical folks are working together and we end up with a smooth transition. It is where we—when we don't have consistency in our goals, we don't have consistency in our plans, where we start to stumble in terms of that transfer and the implementation of specific technology, so we are depending on NASA, but really, for them to be successful, we have to have everybody following a consistent plan so that there is a handoff than can be made to the folks who have to implement.

Mr. HALL. Dr. Porter, do you want to add to that?

Dr. PORTER. No, I think that covers it very well.

Mr. HALL. I guess I would kind of like to know who, at the higher level or the highest level, would be responsible for this? I am not asking for a name. I would take a name if you had it, but a position. Who would do that? Yes, Mr. Shane.

Mr. SHANE. Well, I will give you the name, Mr. Chairman. It is Norm Mineta, the Secretary of Transportation, who, of course, chairs the senior policy committee. The senior policy committee really is an innovation, I think, in the way we have operated within the government in the past. It is, as I indicated in my prepared remarks, a bit of a departure. It involves only the participating agencies at the responsible level, at a political level, and the net result of that is that for each of the participating agencies, you have somebody, the Secretary of Transportation, the Deputy Secretary of Commerce, the Deputy Secretary of DHS, the Secretary of the Air Force, the President's science advisor. Each of these people is actually engaged in the NGATS initiative and each of these folks, particularly those that sit at the top of their respective departments, are in a position to make sure that the priorities established by the senior policy committee actually trickle down to the working level so that nobody is any doubt about the priorities that NGATS is pursuing. Those priorities are agreed in a collaborative fashion through the SPC, the senior policy committee. It is there that the ultimate responsibility resides and it is there that the direction for collaboration is issued. So I think it is the members of the senior policy committee, ultimately led by the Secretary of Transportation, who would have the ultimate responsibility in ensuring that the research is properly focused and is delivering real results in real time.

THE OUTLOOK FOR BUDGET INTEGRATION

Mr. HALL. With that participation and probably led by the Secretary of Transportation, would there be a single integrated budget that includes the contribution of each of them, of each of the agencies that involved in NGATS?

Mr. SHANE. I think that each of us would say that that would be devoutly to be wished, that we continue to work toward that goal. As has already been discussed, we have, in fact, been working together and with OMB to align our budgets to—it is not merely

a question of the agencies themselves working with each other to align budgets. We have to get the Office of Management and Budget to align their examiners, who have their own little stovepipes and who look at our individual budgets in normal times individually, they have to begin to spread themselves across some of those lines in order to bring about what we might call a cross-cut or an integrated budget for NGATS. I think we are approaching that. We are moving in the direction of an integrated budget, but it would be an overstatement to say that we have it today.

Mr. HALL. Dr. Porter, Mr. Pearce, do either of you have anything to add or disagree with him on that? It sounds like he knows what he is talking about to me.

Dr. PORTER. He covered that one well, too.

Mr. HALL. Yeah, okay. All right, well, my time is up. At this time I recognize Mr. Udall.

ENSURING AGENCY COMMITMENTS MATCH NGATS' NEEDS

Mr. UDALL. Thank you, Mr. Chairman. I want to join the Chairman in thanking the panel for your comments and testimony. It is very helpful. If I could, Under Secretary Shane, come back at you again and pursue both this funding question and also the cross-agency budget comment that you made. Can you tell me how the JPDO and the senior policy committee make sure that the agency commitments match the needs of the NGATS's effort?

Mr. SHANE. The leadership comes from the senior policy committee. It is there that the political leaders of each of the participating agencies come together and the needs of NGATS are spelled out in presentations by JPDO in real detail. It enables the participating members of the senior policy committee to really sink their teeth into this material in advance of the meeting, of course, and then discuss it during the meeting and then reach a consensus about the need for alignment. Now each of us is struggling with the same scarcity of resources. That is not—there are no differences among us in that regard, and so it is not easy to align these budgets in the way that I think all of us would like. But the prioritization of activities and the development of a cooperative understanding within the framework of the SBC is what really enables us to move forward at the working level and begin to move these resources into the right place.

AGENCY COORDINATION OF BUDGET CUTS

Mr. UDALL. If I could, let me follow up and ask a specific question tied to that request. And I know Dr. Porter and I talked before the hearing and I certainly want to give her a chance to comment as well and we are going to follow up downstream. But when NASA decided to cut the R&D funding level literally in half, from $146 million to about $71 million, was that decision coordinated in advance with the SBC and the JPDO?

Mr. SHANE. We were certainly—we were notified of that and there was a lot of opportunity for discussion of it. NASA was obviously in a position of having to again prioritize the use of resources that all of us would probably say are too scarce for the amount of responsibility that NASA has. So I won't say that NASA said is

this okay with everybody? This is what we are planning to do, but we certainly discussed it.

Mr. UDALL. It sounds like you were notified as opposed to collaborating or being involved in the process.

Mr. SHANE. I was treated as a fait accompli on the one hand, but we weren't given the opportunity to approve it nor would it have been appropriate, I think, for us to have been given that opportunity.

CROSS-AGENCY BUDGET COORDINATION

Mr. UDALL. That is on the record and I do want to, at some point, have a chance to further that line of questioning here. But Judge Hall talked about the question of funding and the annual coordinated cross-agency budget. Do you know if OMB intends to require you to do that and if so, when?

Mr. SHANE. Frankly, Congressman, I don't know precisely the answer to that question as I sit here today. Administrator Blakey and I went to see the deputy director of the Office of Management and Budget some months ago to talk about this very issue and we were accompanied by several members of the JPDO and it was very clear. They had a variety of examiners sitting there from different sectors of OMB and that was the only thing we were talking about, is how to get these budgets better aligned. I think we are making progress, but I don't want to overstate the case. I think we are making good progress.

Mr. UDALL. Can you provide that information for the record?

Mr. SHANE. I would be happy to, yes.

MAJOR POLICY ISSUES REGARDING NGATS

Mr. UDALL. I think what I am trying to get at is do we need, as I said in my opening statement, a program office that would really drive this, really that question, that comment. You noted in your testimony that the NGATS initiative is unprecedented in scope, complexity and the challenges it will face. From your perspective, what are the main policy issues that will have to be resolved over the next few years if NGATS is to be successfully developed and implemented?

Mr. SHANE. I think you have heard a number of the witnesses talk about those, Congressman. We have to address the human factors issue in a big way. We are really changing in a very serious way, as NGATS proceeds, what people in the aviation sector do when they come to work in the morning, whether they are pilots or air traffic controllers or other participants in the system. They are going to have different kinds of jobs, hopefully far more managerial jobs and far more technology-driven jobs and they have to be developed with a clear view of how to maintain the extraordinary level of safety that we have established over the years. There is not going to be any compromising of that. The idea is to enhance that.

I personally think another major issue for NGATS, although we haven't talked very much about it today, is how to build security into the system in a far more effective way. After 9/11, of course, we did the only thing we could do, which was to layer security on top of a system that was not designed for the kind of security that

we decided we needed after 9/11. With the kind of information technology that is being developed as part of NGATS, it is every reason to believe that security will be embedded in the system, not layered on top of it, that you will have far more information about every aspect of the system. It will deliver a level of security that we have only dreamed about thus far. Those are two of the major issues, I think, that are important. And of course the technology issues themselves are of course the main, the core activity going on with JPDO.

Mr. UDALL. Thank you.

Mr. EHLERS. [Presiding] The gentleman's time has expired. I am sure we will have time for one or two more rounds if necessary and if there is interest. The—let me get at a few questions that follow up on questions I asked earlier. I continue to be very worried about the budget aspects of it and we have had a few questions on that already. Let me just say that, to emphasize the importance of that, and I was not being critical of either you or anyone in the Administration with my comments about budgets being starved, but literally they are. And we as a Congress and we as Americans have to understand that, and I grew up in the depression era and I heard over and over, there is no such thing as a free lunch and you get what you pay for, and that is still true today. And, Dr. Porter, I think you probably suffered the most in the budget and you are smiling and cheering on as best you can, but we all recognize the difficulty you face, and I just want to get a word of caution out for the record, that I think you really going to have to have more funding and better integrated funding if you are going to complete this project, not just the research aspects, but particularly the implementation of the program that you are setting—set out on.

NGATS RESEARCH CHALLENGES

Having gotten that off my chest, as a research scientist, I am very interested in the research challenges you face and could you—let me just ask for anyone who wants to respond to this. What would you say are the three greatest research challenges you face in this entire effort? And then, after you have given that, I am going to ask you what ideas you have to resolve those. Who would like to volunteer? Mr. Pearce.

Mr. PEARCE. I think, as has been noted a few times, the area of human factors is going to contain a number of challenges, and more specifically, as we look at the control within the system and how different—how the system operates, the changes that we would envision between potentially the roles and responsibilities of a air traffic controller or a pilot and then the automation itself that we are planning on adding, sort of where that locus of control finally ends up is an enormously complicated challenge from a human factors perspective, as well as computer science perspective, to bring all of that together. So that is certainly one area.

I think another key area is in the automation itself. So if we are going to be embedding enormously complicated optimization routines into automation and they have got to work in a very failsafe way so that level of complexity, that level of automation, the number of parameters that are going to have be considered, is an extremely challenging research area. Those two really come to mind.

Then outside the—you know, sort of the core air traffic, I think the continuing—if we are going to continue to be able to grow this system from an environmental perspective, I think the vehicle challenges, you know, we are running—actually, we are sort of running out of the easy answers to reducing noise and reducing emissions. And so the continuing reduction, you know, in noise and emissions is going to have to be done through some fairly, fairly rigorous research, a lot more work in embedding our knowledge into very complex computer software and codes in order to be able to do the design work that will lead to aircraft that demonstrate those kind of reductions that we are looking at.

And then finally I guess would just say, in the area of security and sensors, if we really want a sort of a seamless view of how you would pass through an airport with the remote sensing of various aspects of individuals and cargo and so forth, it is going to take some fairly sophisticated sensor development and the integration of that information to create risk profiles. So those areas are some that—I mean, there is a whole more, but those areas come to mind.

AIR TRAFFIC CONTROL AUTOMATION

Mr. EHLERS. Just a quick question on some of the things you mentioned. Theoretically, you could design an air traffic control system in which there would have to be very little human involvement, either in the tower or in the plane. Is that not correct? The failsafe part might be a little tougher, but——

Mr. PEARCE. Yeah, theoretically right. Yeah, there is—yeah.

Mr. EHLERS. Yeah, it wouldn't be all that hard to do, actually.

Mr. PEARCE. Well, well——

Mr. EHLERS. But the failsafe part would be difficult.

Mr. PEARCE. Yeah, yeah. Sort of the idea behind it is relatively straightforward to explain, but it is a very—even just getting the basic automation in place, let alone the failsafe part, is——

Mr. EHLERS. Yeah.

Mr. PEARCE. The nature of that optimization is very complicated. Then to make it all failsafe is very, very difficult.

Mr. EHLERS. Right, I recognize that.

Mr. PEARCE. Right.

Mr. EHLERS. But you—we could enter an era where much of it is automated and the pilots and the controllers are the failsafe mechanisms.

Mr. PEARCE. Yeah, I believe we can, otherwise, you know, we wouldn't be pursuing the concepts we are. I absolutely believe that we can, we can get this job done. We do have automation aids operating in the system today that demonstrate some of the basic algorithms that we will be using for the future, so it is not—these algorithms are not unknown and I think we are in a good position to pursue this research and find ourselves successful.

Mr. EHLERS. All right. The difficulty, of course, would be the—not every airplane is going to be that well equipped. Obviously the large ships will be, but many of the smaller ones won't be.

Mr. PEARCE. Well, that is certainly a difficult policy issue that we are going to have to address, which is the——

Mr. EHLERS. Yeah.

Mr. PEARCE.—equipage and mandates and those issues.

Mr. EHLERS. Right. And there may not be such a thing as VFR anymore. That is a definite——

Mr. PEARCE. Right.

Mr. EHLERS.—possibility.

Mr. PEARCE. Right.

Mr. EHLERS. All right, my time has expired. Next, we will recognize Mr. Costa.

NGATS IMPLEMENTATION ROADMAPS

Mr. COSTA. Thank you very much, Mr. Chairman. It is—I do agree as well that it is important that the Subcommittee hear the subject matter this afternoon because of it is significance and importance today and tomorrow for travel and commerce as it relates not only to our country, but internationally. I have several questions, all which will not be able to be able to asked because of time allotment, but I do want to submit them for the record and hopefully we will get a response back to those.

But let me begin, first, as the Joint Planning and Development, and I don't know, Mr. Pearce, if you want to respond or Dr. Porter, I believe that the great effort that you expended upon today that is going on with NGATS, that it will be able to handle three times the traffic, if the Nation's major airports are not modernized as well, because obviously that is a challenge.

Mr. PEARCE. Yeah, and it is a total system solution that we need to look at. And I would also say that the point we are trying to make is that what we are really looking for is a system that can scale and so——

Mr. COSTA. Well, are you looking at prioritizing, then, because I mean we have the major airports and hubs throughout the country, and then of course I represent a number of smaller airports——

Mr. PEARCE. Right.

Mr. COSTA.—regional airports.

Mr. PEARCE. Right, right.

Mr. COSTA. I mean, how do—have you discussed an implementation phase?

Mr. PEARCE. Well yeah, indeed, we are looking at—we have put together operational approved roadmaps——

Mr. COSTA. Have you——

Mr. PEARCE.—that have laid out when we would need to make these kinds of improvements.

Mr. COSTA. Because Dr. Porter mentioned in her testimony that money will always be short and therefore I think it would be helpful to the Subcommittee and the larger Committee to know what your prioritization is and how we can maybe impact that by providing maybe additional funding. This is a serious issue we are talking about.

Mr. PEARCE. I guess I would request to get back to you for the record in terms of what are—how our current roadmaps are laid out.

BAD WEATHER AND NGATS

Mr. COSTA. I would like you to provide that information to the Subcommittee in terms of the roadmap and the timelines that are

certain to that roadmap. Let me ask you another question. To mitigate the impact, NGATS obviously is hoped to impact the severe weather that we have in our system, and while better airborne radar would be able to provide some benefits, is it not reality that not only the aircraft of today, but the aircraft during—that will be developed over the next 20, 25 years doesn't intend to travel through that bad weather? I mean, obviously, I don't think the airlines would want to be advertising those kinds of rides. So bad weather 25 years from now is still going to look much like it does today. So I mean, how does that benefit?

Mr. PEARCE. There are two kinds of weather. There is——

Mr. COSTA. Good weather and bad weather.

Mr. PEARCE. Well, there are two kinds of bad weather. There is that kind of weather that is, in fact, dangerous. It is severe.

Mr. COSTA. Today we have got good weather.

Mr. PEARCE. And then there is just low visibility conditions. The low visibility conditions is a very solvable problem and they cause a lot of delay issues in the system today. That occurs a lot more often than like what I would call severe weather, like convective thunderstorms and so forth. We don't—we have no plans on flying through convective thunderstorms or anything like it. We—but better ability to manage the system around severe weather is really what we are looking to do.

Mr. COSTA. Well, I just don't want to oversell the benefits of that, is my point, obviously.

Mr. PEARCE. We are putting all of this through modeling simulation so we know precisely what the benefits are of the technologies we are looking at.

AIRPORT MODERNIZATION AND NGATS

Mr. COSTA. Keeping in mind that most of today's delays are due to severe weather, as you noticed, and runway limitations and over-scheduling, is it reasonable for us to believe that your efforts and proposals are going to be able to be implemented, and the Chairman spoke to this, in terms of the cost implementation, in fact, that NGATS obviously already is dealing with delay problems. I mean, it just doesn't seem that—again, not wanting to oversell your efforts with this new technology, if you don't expand runways, if you don't provide additional modernization, there are limitations to what the technical advances are going to provide, right?

Mr. PEARCE. Yeah——

Mr. COSTA. Or am I wrong?

Mr. PEARCE. We can do—we can certainly do more with the runways we have. We can increase the productivity of those runways with technology, but that does not take away from the fact that additional runways will need to be required for the future. There is an airport improvement plan that will have to continue out into the future and those investments will have to be made, but we can do more to create capacity with the runways we do have today.

Mr. COSTA. One—you put your finger on it. I know I am out of time, Mr. Chairman, but you mentioned it several times and that is the resources will have to be found, because without doing that, we are literally living on borrowed time. Thank you very much. I will submit the balance of my questions.

Mr. EHLERS. And thank you. The gentleman's time has expired and next I am pleased to recognize the gentlewoman from Texas, Ms. Jackson Lee.

NGATS BUDGET CUTS AT NASA

Ms. JACKSON LEE. Thank you very much, Mr. Chairman, and I think the witnesses would be able to affirm that most of the Members on this committee are strong advocates of research and development and likewise strong advocates of new aeronautical technology and as well, space, and I might add, supporters of NASA as well. So the questioning is not to be intended as reflecting on our personal commitment to the work that each of you may be engaged in, but I do want to make the general comment that anyone who has flown has heard the redundant conversation about air traffic controllers, delayed flights because of congestion, long stays on tarmac because of congestion, bright sunny days—and I note that one my colleagues just mentioned sunny days or good weather, but I would venture to say to you that there are very often delays with bright sunshine; airports that are basically off limits during certain periods, La Guardia, Newark, and I am not pointing the finger because I happen to come from one of the best airports, Houston. But I will say that they probably have good reason, but many times it is often credited to air traffic controllers and the needs that they have.

So let me—and let me also put on the record that in spite of my strong advocacy for space exploration, I tended to side with the scientists who were quite disappointed in the large cuts of R&D and research that—or science that we had hoped we would see moving forward under NASA. Certainly, we are supporters of the exploration program and our desires to go to Mars, but frankly, I believe we can do both. So, Dr. Porter, let me ask—which may have been asked and answered, but give me a more detailed response to the budget cut from $146.4 million in fiscal year 2006 down to a paltry $71.7 million in fiscal year 2011, that—how does that comport with the research that we are looking to do? In essence, what information do you have from JPDO regarding NGATS's R&D needs that gave NASA the confidence that you cut R&D levels by that amount over the next five years? And what other factors influence the five-year funding profile for air traffic management R&D at NASA?

I would also like—Dr. Dillingham, let me thank you for your presence. But one of the issues I think is prominent, because we know what the air traffic controllers suffered some—almost 20-some years ago. I think it was to our loss, where we scattered professional air traffic controllers across America by busting the union; unnecessary and I think, frankly, a blight on American history. You mentioned in your testimony that you didn't see or have seen that the—there was a lack of participation of the Nation's air traffic controllers in NGATS—in the NGATS initiative. Frankly, give me the truth of that in terms of the seriousness of that problem and what we need to do to gain the experience of these now some seasoned air traffic controllers who managed to stay and come back and then others who have gained experience because, of course, they were newly hired but they have been on for some two decades. So let me yield to Dr. Porter with my frustration of this

paltry funding and whether or not we can be on track with this lack of luster—lackluster participation from NASA.

Dr. PORTER. Thank you for the opportunity to answer that question, because I actually wanted to make a correction for the record. Earlier in February, when our budget it was submitted, there was a mislabel and in fact, I want to make it clear that the entire airspace systems budget, as Mr. Shane referenced, is dedicated directly to the air transportation—air traffic management challenge, the R&D. A very important point that I tried to make in my oral testimony, however, is that NASA's commitment to NGATS is not just about the air traffic management research. Our safety research is also a very important element of the NGATS vision and we have a safety portfolio that, in fiscal year 2006, is $148.4 million.

Ms. JACKSON LEE. And that is shared with the safety issues dealing with space exploration, I take it?

Dr. PORTER. No, it is for aeronautics—aviation safety for the current and future vehicles, and the program is being structured to be proactive to look to the long-term and to ask the—what are the challenges that we are going to face as the NGATS itself evolves? What are the vehicle-related challenges we need to address from a safety perspective?

Ms. JACKSON LEE. Is $141 and the $71 incorrect numbers? Do you have——

Dr. PORTER. The $146 and the $71 that you quoted were from a sub-element of the Airspace Systems Program, and that was my fault. I had mislabeled a slide from back in February and I have since corrected it for the record.

Ms. JACKSON LEE. Correct for me again.

Dr. PORTER. But I will certainly correct it for you again.

Ms. JACKSON LEE. What is it?

Dr. PORTER. It is $174 in 2006.

Ms. JACKSON LEE. Uh-huh.

Dr. PORTER. And $89.4 in fiscal year 2011, which is over the six years that you were referencing. That is the Airspace Systems Program.

Ms. JACKSON LEE. And does that include NGATS funding?

Dr. PORTER. That includes the air traffic management element of NGATS.

Ms. JACKSON LEE. And do you believe that—because that still is a decline.

Dr. PORTER. That is certainly a decline.

Ms. JACKSON LEE. And so I am still going to wage or at least give my criticism and dissent from that, but is that going to produce what we are trying to produce in a timely fashion?

Dr. PORTER. Okay, let me finish answering the first part of your question, because I also want to make the point that in addition to the safety, which is also a robust element of our research portfolio——

Ms. JACKSON LEE. Absolutely.

Dr. PORTER.—the vehicle research that you have heard from testimony from Mr. Pearce, as well, is an incredibly important element of the NGATS. You can't talk about enhancing the capacity of the system unless you talk about enhancing the capabilities of

the vehicles that will fly in that system. So our subsonic project is also dedicated to the advancement, the revolutionary capabilities that are going to be required of those vehicles in terms of noise, emissions, fuel efficiency, which, as you know, is a big challenge today, and just the general performance of those vehicles.

Ms. JACKSON LEE. So the new wave of airplanes is a component to the new wave of technology——

Dr. PORTER. Absolutely.

Ms. JACKSON LEE.—for the air traffic controllers?

Dr. PORTER. Absolutely.

Ms. JACKSON LEE. But you still feel that those components match up to the monies?

Dr. PORTER. I believe that we have done here and what our budget reflects is a balanced portfolio that allows us to address all of those elements, and we would be remiss if we did not address all of those elements.

Ms. JACKSON LEE. Mr. Chairman, indulge me. I thank you very much. I would given a question to Dr. Dillingham, if he would follow up on my question of input, and I would only say, Dr. Porter, you are a good general in terms of carrying the banner. I will continue to express my consternation that it is not enough money, but I do appreciate the efforts you are making and the kind of—and the research that is being pursued. I would say this, Mr. Chairman, I will ask for a timeline, a sort of progress report that shows me that we are keeping up with the research that we are making promises on. But, Dr. Dillingham, the input of air traffic controllers.

AIR TRAFFIC CONTROLLERS AND NGATS

Dr. DILLINGHAM. Yes, ma'am. What I said was in fact truth, as you started out. The situation as we understand it is that FAA asked that the technical liaisons that were attached to headquarters and other parts of FAA return to the towers and to the boards. At that point in time, the air traffic controller union indicated that they would take all of the air traffic controllers out of both the JPDO and as well as the technical liaisons. So the bottom line of it is there are no current air traffic controllers that are working as a part of the JPDO. Instead, what we do have is that FAA has some representatives that were previously on the boards and active controllers, and they have—and when we were preparing for this hearing, they indicated that they were holding a space open for the president of the union on the Institute Management Council. Again, we think this is a serious problem because of the experience in the past when the controllers or the persons who are going to be interfacing with that equipment are not a part of the development, that when it comes time to put the equipment in the system and they see a problem that can be defined as a safety problem, it means that that equipment will not go into the system, it will be delayed and each time a system is delayed, not only are the benefits delayed, but the cost increases substantially.

Ms. JACKSON LEE. Mr. Chairman, I ask unanimous consent for an additional one minute because I think we have hinted on, and I am not sure whether this was hinted on or landed on before I got here, but a fatal flaw. First of all, because there is a tiff between

agencies or between constituencies, we have a blatant abuse of the process by eliminating, if you will, the option for those who are the midst, who can provide insight, to be engaged in this NGATS process. The other downside of this, of course, is a fear of existing air traffic controllers is that what this research will do is to eliminate their positions. So obviously, they are at arms and we have done nothing to allay those fears and we are losing their talents. So I am going to ask this committee to ask the FAA and ask the unions to present with what the tiff is about or why we are in this present frustration.

I see a representative from the Department of Transportation, which I hope might have some information on this. But I don't think we can go forward if we are at odds. We are at—in essence, a large piece is missing from the progress, Mr. Chairman, that we are trying to make and I don't think there is any, how should I say it, substance in the holistic approach to what is occurring without this involvement and I appreciate Dr. Dillingham's willingness to at least bring this to our attention. I don't know how long this has been going on, I don't know if this is a permanent state of affairs. I see there is a seat, an empty seat, is doing nothing. What is an empty seat doing? Empty hat, empty head, empty seat.

So I don't understand what that means for anyone, but I do believe that this is an important research and having experienced the devastation of air traffic controllers in the '80s, knowing the results of that, knowing how we had to sort of reconstruct ourselves and here we are going to the next level, sophisticated air trafficking technology, new aeronautical vehicles, new airplanes and air traffic control. There will have to be some human involvement. I don't believe that we will be all—is that my—Dr. Dillingham, there will have to be some human involvement.

Dr. DILLINGHAM. That is my understanding.

Ms. JACKSON LEE. This is not robotic. There will have to be some human component to this and why they are not involved, I don't know. It may be a minute past—Dr. Shane, excuse me.

Mr. HALL. You asked for a minute and——

Ms. JACKSON LEE. I did.

Mr. HALL.—and you took four minutes to ask the question.

Ms. JACKSON LEE. Four minutes.

Mr. HALL. I have got to yield you five minutes to cover up for the minutes that you have already taken.

Ms. JACKSON LEE. I am happy to be here with my Texan and——

Mr. HALL. And I am happy to yield you another two minutes, if you need it.

Ms. JACKSON LEE. Mr. Chairman, you are very kind. Mr.—Secretary Shane, are you able to solve this problem?

Mr. SHANE. Yes, Congresswoman. First of all, as Dr. Dillingham explained, we have invited the elected representative of the air traffic controllers to participate directly in one of the boards that is overseeing the entire initiative and I cannot offer you a reason why he has chosen not to show up for those meetings. That is an opportunity for all of the controllers to be prominent in the process of developing the system, but quite apart from that, there is no question that we can't move forward with NGATS without the controllers being with us and the—JPDO is, because of the way in

which the FAA has organized the project, voted to the Air Traffic Organization, that is the organization that is the organization that runs the air traffic control system on a day-to-day basis, the technologies that are being developed through the NGATS initiative, through the JPDO, are already being built in to the air traffic control system.

They are being accelerated by NGATS and becoming part of the system. They are becoming part of the system only because controllers are using these technologies. The folks that run the Air Traffic Organization are controllers, the rank and file are controllers, so it would be, I think, a mistake to characterize NGATS as somehow proceeding without the involvement of controllers. We seek greater involvement, make no mistake about that, and we hope that we will see that greater involvement as time goes on, perhaps after we finish our negotiations with the union there will be less of a reluctance to participate straight up, but that is certainly what we have asked for, that is what I hope we will be able to see, but there is no question, Congresswoman, that as we proceed, this will be done in lock step with what our air traffic controllers tell us about what the system needs and what it can do.

Ms. JACKSON LEE. I thank you and out of respect for the Chairman, let me just close by saying I still believe, to the Committee, that I would like to have a more detailed explanation as to why there is this schism of the air traffic controllers in the room and I would hope that they would be able to provide Members of this committee some direct information, but I expect that the Committee should write and receive a sort of a detailed explanation. I don't think the definition that you have given me satisfies me, though I am gratified that what you are saying is there is some participation by way of utilization of some of the new technology. It is not the actual input of air traffic controllers and I would frankly say that one seat on the, on whatever structure it is really does not speak to the general issue of making sure that the air traffic controllers have a wide depth of participation and also that they don't view this as, in essence, technology outsourcing and that they understand that this, they have to be part of the solution and not part of the problem. I yield back, Mr. Chairman, with those expressions of concern.

Mr. HALL. Would you yield to tell Members what questions you want answered and I understood you wanted a timeline for a report?

Ms. JACKSON LEE. Yes, sir, Mr. Chairman. I understood——

Mr. HALL. I ask unanimous consent of the Committee and you and I will have an awful lot to do about whether we grant that unanimous consent.

Ms. JACKSON LEE. I have unanimous consent, Mr. Chairman. Thank you. I would appreciate, even with Dr. Porter's explanation, a more detailed response to the budget decline that NASA is engaged in with respect to the NGATS study. I am not convinced that it is not enough money for the R&D. I want to see where the monies are going, specifically the safety money and I want to know that there is a timeline that says that we are not getting off the timeline of research and development because we don't have enough money, so I want to be able to match money with timeline

and whether we are doing all the research and development we were supposed to do originally.

Mr. HALL. Do you direct that to the entire committee or do you specify anyone that you want to give that—which of you are more capable of giving that information?

Ms. JACKSON LEE. That would be a good broad and I would specifically encourage NASA to provide us with that answer.

Mr. HALL. Dr. Porter, can you do that? And the time limit, can you do it—how much time will you need?

Dr. PORTER. What was your question, the time?

Mr. HALL. Do you need a couple of weeks' time?

Dr. PORTER. Yes.

Mr. HALL. Is that satisfactory.

Dr. PORTER. Yes.

Ms. JACKSON LEE. Mr. Chairman, I would also add Secretary Shane, as well, if he would provide that answer.

Mr. HALL. Okay. I thank you very much.

Ms. JACKSON LEE. And I have a second question, is to try to have an explanation of this either schism or break between the air traffic controllers union, I understand, and the lack of sitting on the seat and whether or not we truly have, as Dr. Dillingham has brought to our attention, full participation of air traffic controllers, plural; not a seat, but a way to have their involvement so that the technology can be reflective of their knowledge. I would imagine that we would hear from Secretary Shane, that we would hear from the—Dr. Dillingham may want to contribute further on this discussion and it looks as if the acting director of JPDO might also be—and then Mr. David Dobbs, who is the Assistant Inspector General. You all can provide me with your insight on this issue. Thank you, Mr. Chairman, for your indulgence.

HUMAN FACTORS RESEARCH SUPPORTING NGATS

Mr. HALL. All right, thank you. I just have a question or so. Mr. Dobbs, based on planning documents that you have seen to date, what are your views about the adequacy of human factors research supporting the NGATS? Is it turned on?

Mr. DOBBS. Yes, I think it is on now, right?

Mr. HALL. Yes, sir.

Mr. DOBBS. Okay.

Mr. HALL. And I asked Dr. Dillingham the same questions, so be ready.

Mr. DOBBS. Okay. Could you repeat the question, please?

Mr. HALL. Based on planning documents that you have seen to date, and I think you, some of your testimony alluded to that, what are your views about the adequacy of human factors research supporting NGATS?

Mr. DOBBS. I think the——

Mr. HALL. Dr. Dillingham, do you know what I am asking?

Dr. DILLINGHAM. Yes. Yes, sir.

Mr. HALL. Let us give him some help there.

Dr. DILLINGHAM. We don't usually help the IG, but in this case.

Mr. HALL. It is late.

Dr. DILLINGHAM. I think one of the most important elements of human factors research that we have identified as a possible gap

is to try to understand what it is going to mean when you move so much of the control from the air traffic controllers to the pilots and our understanding, from talking with JPDO is that they have not yet been able to identify a model that will allow them to model that and that is compounded by trying to locate data that they can use to operate that model. So that probably is the biggest human factors issue that we see, in addition to the point that we don't want to raise anymore the fact that the air traffic controllers, the current air traffic controllers are not participating in the IPTs.

Mr. HALL. Well, if Ms. Jackson Lee was here, I know she would want me to ask this question, so are human factors being given the resources it is going to require or it deserves? That would be her question and I will ask it in her behalf a lot quicker than she would ask it.

Dr. DILLINGHAM. Our interviews and research at JPDO doesn't indicate that human factors is being shortchanged and in fact, it is a part of the suite of models that they have developed and in fact, there is some work actually going on with human factors with regard to the controllers, themselves. It is just a matter—it is our understanding that it is just a matter of locating an appropriate model and the data to run the model for the pilots, themselves.

Mr. HALL. I thank you for that. Mr. Dobbs, do you want to add anything to it or disagree with him?

Mr. DOBBS. I agree with that.

NRC'S RECOMMENDATIONS CONCERNING INTEGRATED PROJECT TEAMS (IPTS)

Mr. HALL. All right. Mr. Hudson and Mr. Pearce, in 2005 the National Research Council recommended that the JPDO restructure its integrated product teams and to do it in the three coordinated areas, airport operations, terminal operations and en route operations, rather than the eight current teams and the JPDO decided not to implement this recommendation and I guess my first question there is can you explain why they didn't implement the recommendation?

Mr. HUDSON. I believe Mr. Pearce and answer the question and I can expand on why we thought there should be three instead of eight.

Mr. PEARCE. You said offer a couple of reasons. One is that our understanding of why the NRC focused on those three was, one was to really emphasize capacity as the real driving goal and metric of the JPDO. And so those IPTs are the ones that we—or that structure would be best suited to address the capacity goal. Our mission, however, as structured and as we are currently implementing it, includes not only changes, not only transformation of the air traffic system and the ability and capacity, but also transformations in how we manage safety, transformations in how we do security in the system, environmental performance and so forth, so given the scope, the continued broad scope we have for JPDO, we didn't think that it was appropriate to narrow down to those specific IPTs.

The other concern we had is that in looking at—even if we just looked at the air traffic management portion of this, we didn't necessarily want to over emphasize kind of the current structure of

terminal and en route, oceanic, airport environment and so forth, because what we are really looking at is how do we integrate those environments and create a very smooth operation from gate to gate and so we didn't want to necessarily stovepipe it in that way and potentially lose the synergies of working across those domains. So those were the rationale for not necessarily adopting those specific IPTs. What we have talked about quite a bit and what I think is very valid out of there, out of the NRC study is that it is very difficult to manage eight IPTs, so the more IPTs we have the more difficult it is from potentially having stovepipes and just managing across all those boundaries, so that is very, very valid and we continue to be concerned and we are certainly paying attention to those part of the recommendations.

Mr. HALL. I thank you for that. Mr. Hudson, you were going to tell us why the NRC thinks that it was a better approach.

Mr. HUDSON. When we looked at it, the first—our first thought was that this is a valuable tool to use the eight, because you do get the involvement of the various agencies and the structure of the eight somewhat parallels the stakeholders in the organization. As we looked deeper, it appeared to us that they were not addressing the final products which would come out of these IPTs and that they needed to be structured along the way operations actually happen the airline business or in the air transport business. I would use the example of safety. Having a safety IPT sounds like a good idea, but it is somewhat analogous to what we did in industry where we used to try to inspect quality into the product out at the end of the production line.

So if you—safety, security, those items need to be an integral part of each of the major phases of the program and having a standalone safety item doesn't guarantee and assure that it is going to be part of the culture of the entire operation, so it was in that context we said pick, at least three appeared to be, from those people on the committee, who had experience in running airlines and designing systems, to be the three obvious products that the IPT would produce. How do you run your airport, how do you run the—manage when you start clustering airplanes up to handle them at the airport and then how do you handle the rest of the world, so those are the three that the committee came up with and we said okay, now take your IPTs that you have, shred them and integrate them into those areas and we would have a true integrated product team approach, so that is how we came to that conclusion and we felt very strongly about it and put it into the report.

Mr. HALL. I want to thank you and I didn't get to hear all the testimony. I did listen to much of it when I was out of the room, but I think you have made a good record and the record is going to be very valuable to us and the record we seek is a very, very important and an almost a tender problem that involves hard, hard work; long, long hours; pressure, unbelievable pressure; and the safety of a nation involved in it and I strap to one of their airplanes twice a week and come up here from Dallas and back I am terribly interested in knowing that we are giving them the best tools to work with and that we are being fair with them and being appreciative of folks like you that are planning and trying to spawn an answer to the things as they affect us and how they affect us and

how we can cure them. And all of us, on behalf of those that aren't here, I want to express my appreciation to you for your good time that you spend every day working along this way and the time you spent with us here today and with that, we are adjourned.

[Whereupon, at 3:50 p.m., the Subcommittee was adjourned.]

Appendix:

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Jeffrey N. Shane, Under Secretary of Transportation for Policy, U.S. Department of Transportation

Questions submitted by Chairman Ken Calvert

Q1. What critical policy decisions must be made by the Senior Policy Committee before the JPDO can start down a particular technology and architecture path? For example, do decisions need to be made on the degree to which responsibility for aircraft can be handed over to automated systems, or whether some airplanes will be allowed to fly using "Visual Flight Rules" instead of filing a flight plan, or how NGATS will treat commercial aviation vs. general aviation? What significant policy issues do you think fall into this category?

A1. The Senior Policy Committee provides guidance and review; makes legislative recommendations; and identifies and aligns resources that will be necessary to develop and implement the NGATS Integrated National Plan.

The process of identification, analysis and coordination of Senior Policy Committee Level NGATS policy issues follows a path that runs parallel to the NGATS Enterprise Architecture. As the architecture iterations take place, the necessary SPC level policy decisions become increasingly clear. That's why many of these important policy issues, as well as their substance and timing will be easier to discuss once the Enterprise Architecture is developed.

To help illustrate this point, some of the upcoming policy issues that are likely to evolve from this process include:

Changes in roles and responsibilities: New modes of operation, as noted in the question, are likely to necessitate further policy decisions. Substantial increases in traffic flow, new and diverse traffic types and perhaps most significantly, the use of automation in complementing human roles to handle increased traffic, will likely have the impact of shifting roles and responsibilities.

Define Required Total System Performance (RTSP): Understanding and defining the performance framework, its associated levels of performance, and commensurate levels of service, are critical early steps, and policy issues, that need to be addressed in order to implement NGATS.

Safety Assurance: The NGATS approach, as explained in our vision, would change the regulatory authority's role from testing, inspecting, and certifying individual system elements to comprehensive approval and periodic audits of the safety management programs within the civil aviation industry.

Q2. Has the JPDO considered contracting out much of the work to implement NGATS to a lead systems integrator: What are the advantages and disadvantages of bringing in a lead system integrator for NGATS.

A2. The focus of the JPDO during this first phase of its operation has been on planning. This work has been accomplished through the Integrated Product Teams (IPTs) which are organized around the key strategic areas identified in the NGATS Integrated National Plan. The mission of the IPTs is both to plan and implement the NGATS initiative.

Some of the initial products of the JPDO's planning work will include the NGATS Operational Improvement Roadmap, the Concept of Operation and the Enterprise Architecture. However, while the initial work of the JPDO has a planning focus, as the initiative continues to evolve, there will be a shift from an environment that is oriented primarily around planning towards one that has both a planning and implementation focus.

At that point the JPDO will need to reexamine its available skill sets and personnel makeup to evaluate whether or not it has the necessary mix of capabilities to meet its implementation requirements. One possibility, and this has yet to be evaluated, may be to rely to some degree on a lead systems integrator.

Q3. Does the Administration intend that the NGATS would be implemented by the JPDO or that the JPDO is to develop the plans and the implementation would be handled by another organization? If it is the latter, please explain what organization would be responsible for implementing NGATS and how the transition is to be made from JPDO to this organization.

A3. The JPDO by its very design is intended to be both a planning and implementation organization. In its early stages the JPDO has been heavily focused on planning. The principal role of the Integrated Product Teams (IPTs) during this phase

of the NGATS development has been focused on developing the concepts of use and their input to the NGATS Concept of Operations and the Enterprise Architecture. These critical elements of the NGATS planning process are the foundations of the initiatives' implementation.

However, while this critical work in planning NGATS has been proceeding, the organization has also been evolving into its role as an implementing organization. An example of its work in implementing NGATS is the budget guidance provided by the JPDO to each of the agencies concerning necessary development work, implementation plans, and research that is focused on implementing NGATS capabilities. Further, an important part of the implementation process is in development of the specific actions and investments the agencies will need to make in order to implement the initiative. To do this, the JPDO is developing a series of specific investment portfolios that will serve as a guide to the future implementation of NGATS.

Questions submitted by Representative Mark Udall

Q1. Will OMB require the agencies involved in the JPDO to develop an annual, coordinated, cross-agency budget laying out the resource allocations by agency and by JPDO-defined goal? If so, when?

A1. The JPDO's role in working with the NGATS partner agencies is to facilitate the alignment of the agency budgets to support the research, development and implementation work necessary for NGATS. The JPDO issues budget guidance, in accordance with the needs of its Operational Improvement Roadmap, to each partner agency outlining specific expectations and direction around key capabilities and programs. This includes requirements for research, program development and implementation. The JPDO then works with the respective agencies, under the direction of the Senior Policy Council, to identify how well they have been able to meet the objectives of our budget guidance. This process is collaborative and allows the JPDO to work with the agencies to identify gaps in funding, while at the same time potentially finding additional capabilities that may need further work.

Q2. Dr. Dillingham's testimony states that "there is no formalized long-term agreement on the partner agencies roles and responsibilities in creating the NGATS." According to JPDO officials, a memorandum of understanding that would define partner agency relationships was being developed as of August 2005, but has not yet been completed? Why have you been unable to formalize a long-term agreement on the partner agencies roles and responsibilities? When do you expect to have such an agreement completed?

A2. A draft MOU is now in the process of formal coordination with the JPDO Board members. Final approval, contingent on the resolution of any comments and disagreements, should occur in the next few weeks.

Q3. Through what mechanisms are the view of industry being incorporated in the JPDO planning process, and how well are those mechanisms working thus far? What if anything, would you recommend be done to improve the interaction of industry and the JPDO planning process.

A3. The primary mechanism for incorporating the views of industry is through the NGATS Institute, which was established for the express purpose of ensuring the involvement of the private sector in the JPDO. Through this mechanism there are now 200 *pro bono* private sector participants on the JPDO IPTs. In addition, funded studies to support the definition of NGATS will begin shortly. This new form of collaboration is still in its early stages. Nevertheless, the Institute has surveyed their members to gain insights on where improvements can be made and we are in the process of establishing an action plan to address what we have learned.

Q4. Are there any technology transfer issues that need to be addressed? Will NASA, for example, support development activities to the point where industry will pick up advanced development needed for deployment of key technologies?

A4. Technology transfer is a critical issue for the JPDO. To achieve the goals of the NGATS initiative technology has to transition from research into operation. This means that as research matures there has to be an active, technical partnership between those performing the research and those involved in implementation of the technology. That partnership should be dynamic and include the validation of these technologies at various stages of the development. It should also be focused on ensuring that the technology can be implemented with an acceptable level of risk.

The JPDO has a profound interest in developing and facilitating this kind of partnership. Aggressive transfer of capabilities from research to testing and then implementation is a critical element in assuring the success of NGATS.

Questions submitted by Representative Frank D. Lucas

Q1. Are you considering future modern ground based Multi-mission 3D Phased Array Radars as a national network in your surveillance concept? Multi-mission means simultaneous surveillance of weather and all aircraft including non-cooperative ones. If not, why not?

A1. Though the focus of much of the work behind NGATS is on satellite and network based navigation systems, systems and applications that don't rely so heavily on radar, actual decisions about the mix of new technologies and the application of more advanced radar systems is still being evaluated. Many of the decisions regarding future technology will be based on the incremental implementation of the NGATS architecture. The Enterprise Architecture defines many of the applications and future technologies that will compromise the NGATS initiative.

Question submitted by Representative Sheila Jackson Lee

Q1. What is the reason for the lack of participation of the air traffic controllers in the activities of the JPDO, and what is the impact of their lack of participation?

A1. The reason that active air traffic controllers have not participated to this point it is still too early in the process. Currently, the JPDO has focused more on budgets, processes, policy, and plans than anything else. When the JPDO moves further down the line and are discussing, systems, procedures, separation standards, and airspace the subject matter experts—the air traffic controllers—will be brought into the process.

However, the JPDO staff includes former air traffic controllers. These individuals provide substantial expertise that is helpful in this early stage of NGATS development.

Questions submitted by Representative Jim Costa

Q1. Does the JPDO believe that the Next Generation Air Transportation System (NGATS) will be able to handle three times today's traffic if the Nation's major airports are not modernized as well?

A1. The JPDO believes that airports are part of the transformation effort. The JPDO assumes that new runway development will continue to occur where demand dictates. In addition, from an operations perspective, the JPDO is examining "super-density" operations at the Nation's most congested airports. This capability will increase throughput on individual runways and reduce or eliminate capacity-limiting dependencies between the set of runways at an airport. Super-density will also allow, at some airports, an additional runway to be built between existing parallel runways without any capacity-limiting dependency.

JPDO is also working toward the ability to handle greater airspace terminal area complexity, allowing airports neighboring large hubs to integrate seamlessly, and allowing them to serve more traffic as demand and demographics dictate. Finally, the JPDO is studying issues of airport terminal flows and security operations that will allow greater passenger flow from the curb to the gate.

Q2. How will the NGATS be able to mitigate the impact severe weather has on the system?

Q3. Keeping in mind that nearly all of today's delays are due to severe weather, runway limitations, and over scheduling: Is it reasonable for us to believe that the billions of dollars the JPDO's proposals are sure to cost in the implementation of the NGATS will solve the delay problems we already face today?

A2, A3. In addressing the issue of weather NGATS focuses on several factors. First, in today's operational environment, low visibility conditions reduce the efficiency of flight operations leading to delays in the system. NGATS is focused on integrating several technologies and procedures to create an "equivalent visual" capability that would eliminate low visibility as an efficiency and delay problem in the system.

Second, the JPDO is pushing to integrate today's weather forecasting and dissemination systems into an integrated, network-based weather data system that would

directly feed flight management automated systems. These systems would provide the most efficient, highest capacity routes around severe weather systems.

All of the changes that JPDO proposes will be validated through high-fidelity modeling and simulation and eventually through flight operational demonstrations to confirm that sufficient benefits will accrue to justify the investment. As a part of this effort, the JPDO will maintain objective metrics of capacity, cost, and safety.

Q4. What does the JPDO see as the most urgent problem that needs to be addressed in the near future, not 25 years down the road?

A4. The JPDO has generated its first draft of the detailed Operational Improvement Roadmap that lays out the transition from today to the NGATS end-state. In the near-term, critical infrastructure, such as cooperative surveillance and digital ground-to-air data communications need to be established to support 4D flight trajectories and higher capacity operations. In addition, the policies associated with a performance-based National Air Transportation System need to be established to ensure aircraft are capable of taking advantage of this infrastructure and associated services.

It is also critical that the research programs are established that ensure that the critical automation needed to achieve the full capacity benefits are available by the end of the next decade. In addition, safety and environmental research is also critical to ensure that safety and environmental compatibility keeps pace with the rise in operations.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Lisa J. Porter, Associate Administrator for Aeronautics, National Aeronautics and Space Administration (NASA)

Questions submitted by Chairman Ken Calvert

Q1. In your testimony, you emphasized that—in addition to the work being done by Airspace Systems—NASA's contribution to the JPDO includes research conducted by Fundamental Aeronautics and Aviation Safety. Please provide a list of projects in these areas and describe how they contribute to the JPDO.

A1. The Subsonic Fixed Wing (SFW) project in the Fundamental Aeronautics Program directly supports the Next Generation Air Transportation System (NGATS) goal of tripling air traffic throughput with no increase in noise or emissions. Historically, technology has enabled significant reductions in aircraft noise, specific fuel consumption (SFC) and emissions. The GE90 and Boeing's 777, although still commonly viewed as state-of-the-art, contain technology now over a decade old. Although best in the market presently, these systems will not provide the requisite noise and emissions levels needed to attain the NGATS projection of 3X growth while maintaining, or reducing, current noise and emissions levels. To achieve the NGATS vision of tripling throughput with no increase in environmental impact will require an infusion of novel technology.

Significant noise and emission reductions are attainable for future generations of conventional aircraft if we invest in fundamental research to enable major changes to engine cycle and airframe configurations. The development of unconventional systems, such as a Hybrid Wing Body, could also potentially result in desired noise, emissions, and performance improvements. Therefore, the SFW project will focus on cutting-edge research in critical disciplines such as materials and structures, aerodynamics, and propulsion, to help achieve these goals. Although a key focus of the project will be on transport aircraft (both conventional and unconventional), we will also conduct assessments to identify the potential benefits of new technologies that can enable a wide array of sizes of subsonic vehicles such as Very Light Jets (VLJs) and new capabilities such as Extreme Short Takeoff and Landing (ESTOL).

The Aviation Safety Program and its four thrust areas will continue to focus NASA research on improving the inherent safety attributes of aircraft and to enhance the safety of the Nation's current and future air transportation system. NASA will directly address the fundamental aircraft safety research needs of the NGATS in partnership with the member agencies of the JPDO's Safety Integrated Product Team (IPT).

There are four projects within the Aviation Safety Program: Aircraft Aging and Durability (AAD), Integrated Intelligent Flight Deck Technologies (IIFDT), Integrated Resilient Aircraft Control (IRAC), and Integrated Vehicle Health Management (IVHM).

Several of the principles in the NGATS vision for a flexible, resilient, scalable, adaptive and highly automated system will be supported by AAD research. One of the principles, Integrated Environmental Performance, involves addressing environmental issues in a way so as not to hinder growth, nor impede the ability to meet demand. AAD research in lightweight engine fan containment and higher operating temperature turbine disk materials will enable new engine configurations for current and future vehicles that burn less fuel and generate less noise. Another principle, Proactive Approach to Safety Risk Management, speaks to assessing risk and anticipating potential safety problems so we can prevent accidents before they happen. Integrated methods developed by AAD to characterize aging-related degradation, model failure mechanisms and useful life, and mitigate the hazards, will provide data and capabilities to enable condition-based maintenance of vehicles.

The JPDO concept requires a shift in the historical model of air transportation from a system based on established physical/technology infrastructure and the capabilities of service providers to a system that is flexible and adaptable to the varied needs and capabilities of its users. This concept also requires that safety be approached in a prognostic fashion and promotes a new safety culture that exploits risk from a predictive perspective. The IIFDT project supports this concept by developing adaptive flight deck systems, ensuring flexibility not only on the system-end, but also on the user-end, and with proactive, predictive design and risk assessment tools and techniques necessary for NGATS implementation.

IIFDT uses as a guide an assumed future state of the U.S. National Airspace System (NAS). This future state is based upon the current vision described by the JPDO. As envisioned, the roles and responsibilities of the flight deck elements are

clearly expanded. As envisioned, flight deck systems will have access to increasing amounts of information and new and innovative means of communicating its desires to an Air Traffic Management (ATM) system; there will be a move from "see-and-avoid" toward "sense-and-avoid" flight operations, and there will be a delegation of varying levels of responsibility to the flight deck for managing separation and generating/negotiating 4D trajectories relative to weather and other ATM constraints. Each of these capabilities is considered from a vehicle-centric safety perspective by the IIFDT project.

In addition, the degree of automation in the aircraft and in the ATM system will increase. Direct pilot/controller communications will be reduced and replaced by agent-based interactions between air and ground systems. The demands of these future systems and the need to keep the flight crew fully aware of current and future safety and ATM situations are challenges for the IIFDT research. An initial assumed future state is made by IIFDT to establish the context of the initial work. Subsequent updates to this assumed future state are made in close coordination with NASA's Airspace Systems Program and based on the research progress. These revisions may require adjustments to our plan as priorities change and as safety issues emerge or are resolved. This approach ensures an integrated and relevant technology tool set in support of NGATS as it comes on-line.

The IRAC project will conduct research to advance the state of aircraft flight control automation and autonomy in order to prevent loss-of-control in flight, which is the accident category that currently has the highest number of aircraft accidents. Taking into account the advanced automation and autonomy capabilities as envisioned by NGATS, the research will pursue methodologies to enable an aircraft to automatically detect, avoid, and/or safely recover from an unusual attitude or adverse condition.

The goal of the IVHM project is to develop technologies to determine system/component degradation and damage early enough to prevent or gracefully recover from in-flight failures. The project will develop tools and techniques to (1) determine the state of subsystems (airframe, propulsion, electrical power, avionics, hydraulics and electromechanical) such that the state of the entire vehicle can be determined by accurate prognosis, (2) diagnose coupled degradation/malfunction/failure/hazard conditions and predict their effects on vehicle safety, and (3) mitigate damage/degradation/failures in flight. This project is clearly aligned with the NGATS vision of future air vehicles that use new materials and design processes for improved resistance to impact damage and flammability, with automatic health monitoring combined with self-healing systems in aircraft.

Questions submitted by Representative Mark Udall

Q1. Through what mechanisms are the views of industry being incorporated in the JPDO planning process, and how well are those mechanisms working thus far? What, if anything, would you recommend be done to improve the interaction of industry with the JPDO planning process?

A1. The primary mechanism for incorporating the views of industry is through the NGATS Institute, which was established for the express purpose of ensuring the involvement of the private sector in the JPDO. Through this mechanism there are now 200 *pro bono* private sector participants on the JPDO IPTs. It is still early in the process, with private sector involvement beginning less than six months ago. Nevertheless, the institute has surveyed their members to gain insights on where improvements can be made and we are in the process of establishing an action plan to address what we learned.

Q2. Are there any technology transfer issues that need to be addressed? Will NASA, for example, support development activities to the point where industry will pick up advanced development needed for deployment of key technologies?

A2. Technology transfer is a critical issue for the JPDO. To achieve NGATS, technology has to transition into operation, which means that as research matures there has to be an active, technical partnership between those performing the research and those involved in implementation of the technology. Research is being conducted by all of the JPDO member agencies in support of the common vision, but the FAA ultimately has the lead role in its implementation. Therefore, the JPDO will have to be completely cognizant of the technical developments of the research being conducted in support of the NGATS to understand and help manage the system requirements development as the research matures.

Questions submitted by Representative Sheila Jackson Lee

Q1. According to your testimony, NASA's budget for air traffic management R&D will decline from $174 million in FY 2006 down to $89.4 million in FY 2011.

What information from the JPDO regarding NGATS R&D needs gave you confidence that NASA could cut its R&D funding level by that amount over the next five years?

Q2. What other factors influenced the five-year funding profile for air traffic management R&D at NASA?

A1, A2. NASA is putting a strategic plan in place that addresses many of the research challenges facing the successful realization of the JPDO vision for the Next Generation Air Transportation System (NGATS). While ATM is a significant element of that vision, it is not the only challenge that must be addressed. The future air vehicles of the system will need to address substantial noise, emissions, efficiency, and performance challenges. These challenges will be addressed in our Fundamental Aeronautics Program. Furthermore, as we develop increased capabilities in our future air vehicles and airspace system, we must continue to conduct the research necessary to ensure that our high safety standards are not compromised. Our Aviation Safety Program will address aircraft safety technological barriers that would otherwise constrain the full realization of the NGATS. Thus, in addition to the fact that the entirety of the Airspace Systems Program is devoted to ATM research in support of NGATS, a substantial amount of research conducted in the Fundamental Aeronautics Program and the Aviation Safety Program will also directly address NGATS challenges. NASA has constructed a balanced research portfolio that draws upon our NASA-unique capabilities to address ATM, environmental, and safety-related research challenges, *all of which must be worked in order for the NGATS vision to be realized in the JPDO mission.*

It should be noted that much of the decline quoted occurs from FY 2006 to FY 2007, consistent with the overall decline in the aeronautics budget from FY 2006 to FY 2007. The FY 2007 budget for ATM research in support of NGATS is $120 million and remains essentially constant in FY 2008, with a decline in the outyears to $90 million in FY 2011. It should also be noted that the decline from FY 2006 to FY 2007 in the Airspace Systems program is due in part to the phasing out of certain projects. The Small Aircraft Transportation Systems (SATS) was scheduled to be completed in FY 2006 after a successful demonstration in June 2005. UAVs in the NAS have been transitioned to the FAA, per direction from the FY 2006 NASA Appropriations language. The Space-Based Technologies Project has also been phased out, because it was duplicative of research being conducted by the DOD. The sum total of these FY 2006 budgets was $13.6 million. In addition, $8.0 million of site-specific earmarks were not included in the FY 2007 budget. These items represent over 12 percent of the FY 2006 Airspace Systems budget.

Finally, it is important to recognize that while the NGATS vision is a very important element of NASA's aeronautics research portfolio, NASA has an obligation to ensure that it applies its unique research capabilities to other national needs. This obligation includes partnerships with the DOD and industry in support of cutting-edge research in hypersonics, supersonics, subsonic fixed wing and rotorcraft. This obligation also includes a commitment to support the *Vision for Space Exploration* by conducting fundamental, cutting-edge research in such areas as hypersonics, supersonics, aerothermodynamics, advanced materials, and integrated vehicle health management.

Questions submitted by Representative Jim Costa

Q1. Does the JPDO believe that the Next Generation Air Transportation System (NGATS) will be able to handle three times today's traffic if the Nation's major airports are not modernized as well?

A1. The JPDO believes that airports are part of the transformation effort. The JPDO assumes that new runway development will continue to occur where demand dictates. In addition, from an operations perspective, the JPDO is examining "super-density" operations at the Nation's most congested airports. This capability will increase throughput on individual runways and reduce or eliminate capacity-limiting dependencies between the set of runways at an airport. Super-density will also allow, at some airports, an additional runway to be built between existing parallel runways without any capacity-limiting dependency. JPDO is also working toward the ability to handle greater airspace terminal area complexity, allowing airports neighboring large hubs to integrate seamlessly, allowing them to serve more traffic

as demand and demographics dictate. Finally, the JPDO is studying issues of airport terminal flows and security operations that will allow greater passenger flow from the curb to the gate.

Q2. How will the NGATS be able to mitigate the impact severe weather has on the system?

A2. The NGATS seeks to minimize the adverse effects of weather on air transportation. Today, uncoordinated weather data and forecasts are often provided to local decision-makers who make their own judgments on how to use the data; this often results in ineffective or conflicting decisions. The NGATS, relying on real-time network-centric distribution of information, will provide an up-to-the-minute, common weather picture to all decision-makers. This data will also be inserted into new algorithms and processes that will reduce or eliminate the need for human interpretation. NASA's research into traffic flow management validates algorithms and processes for probabilistic weather information that are required to increase airspace capacity by enabling efficient traffic management and dynamically adjusted system flows mitigating the impact of severe weather events.

The NGATS also seeks to implement Equivalent Visual Operations at air portals. This will increase capacity by enabling pilots to navigate without visual references and maintain safe distances from other aircraft during non-visual conditions, such as low clouds or fog. NASA's research in surface management optimization and wake vortex prediction will employ the network-centric distribution of weather information enabling important elements of Equivalent Visual Operations.

Q3. Keeping in mind that nearly all of today's delays are due to severe weather, runway limitations, and over scheduling: Is it reasonable for us to believe that the billions of dollars the JPDO's proposals are sure to cost in the implementation of the NGATS will solve the delay problems we already face today?

A3. The transformation that the JPDO proposes fully accounts for the issues facing the system today and into the future, including weather. Specifically with respect to weather, NGATS focuses on several factors. First, today, low visibility conditions reduce the efficiency of flight operations, leading to delay in the system. NGATS is focused on integrating several technologies and procedures to create an "equivalent visual" capability that would eliminate low visibility as an efficiency and delay problem in the system. Second, the JPDO is working to integrate today's weather forecasting and dissemination systems into a network-based weather data system that would directly feed automation systems. Such automation systems would provide the most efficient, highest capacity routes around severe weather systems.

All of the changes that JPDO proposes will be validated through high-fidelity modeling and simulation and eventually through flight operational demonstrations to confirm that sufficient benefits will accrue to justify the investment. As a part of this effort, the JPDO will maintain objective metrics of capacity, cost, safety, etc.

Q4. What does the JPDO see as the most urgent problem that needs to be addressed in the near future, not 25 years down the road?

A4. The JPDO has generated its first draft of the detailed operational improvement roadmaps that lays out the transition from today to the NGATS end-state. In the near-term, critical infrastructure, such as cooperative surveillance and digital ground-to-air data communications need to be established to support 4D flight trajectories and higher capacity operations. In addition, the policies associated with a performance-based NAS need to be established to ensure aircraft are capable of taking advantage of this infrastructure and associated services.

It is also critical that research programs are established that ensure that the critical automation needed to achieve the full capacity benefits is available by the mid-teens. In addition, safety and environmental research is also critical to ensure that safety and environmental compatibility keeps pace with the rise in operations.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Robert A. Pearce, Acting Director, Joint Planning and Development Office, Federal Aviation Administration

Questions submitted by Chairman Ken Calvert

Q1. Please explain the process by which participating agencies' budgets for JPDO-related activities are coordinated and integrated for review.

A1. The JPDO plays an active role in working with the respective NGATS partner agencies to assure the alignment of the programs and budgets that are necessary to support the initiative. Each year, the JPDO issues budget guidance to each partner agency outlining specific expectations and direction around key NGATS capabilities and programs. This guidance is closely tied to the NGATS Integrated National Plan and the Operational Improvement Roadmap. The guidance includes requirements for research, program development and implementation. The JPDO works closely with the respective agencies to identify how well they are doing at meeting the objectives of our budget guidance. The process involves a comprehensive alignment of agency budget items and needed NGATS capabilities. This process allows the JPDO to identify gaps in funding as well as any new requirements that the agencies might recommend as being necessary to support NGATS capabilities.

Q2. Please provide a consolidated FY07 budget request showing each agencies contributions to JPDO related activities.

A2. The JPDO is jointly funded by NASA and the FAA. In FY07 each agency requested $18 million to fund JPDO related activities.

Q3. Several witnesses noted the importance of human factors research being integral to development of the NGATS. Does the JPDO portfolio include human factors research? If so, how much funding is going into this research and which agency is performing it?

A3. One of the key objectives as defined in the NGATS Integrated National Plan is the funding of research to evaluate the alternative allocations of air traffic management services "between the ground and the air, and between automation and the "human" component." This element of NGATS, in other words, human factors research, is an important and critical component of the initiative. At this point however, much of the initial work on NGATS has been focused on the foundational programs that will support the initiative. Of course, human factors research, as it relates to operations within the National Airspace System is conducted by both NASA and FAA. However, specific research focused on NGATS, while planned, has not begun yet.

Q4. FAA has a mixed record in adopting new technologies for the air traffic control system. What steps are being taken to ensure that technologies developed by NASA and other participating agencies will be successfully transitioned into the operational NGATS?

A4. The challenge in implementing any new technology is working with the user in a partnership to be able to achieve a true operational transition. This means that as research matures there has to be an active collaboration between those performing the research and those involved in implementation of the technology. That is the challenge that the JPDO, by working so closely with NASA and the FAA, as well as the other partner agencies and the private sector is addressing. Our goal, by achieving this partnership is to assure a more rapid, efficient and comprehensive implementation of new technologies and capabilities.

Questions submitted by Representative Mark Udall

Q1. Describe how and to what extent NOAA is involved in weather-related R&D needed to advance the NGATS.

A1. NOAA leads one of the JPDO's eight Integrated Product Teams. The function of that IPT is to develop a system-wide capability to reduce weather delays. The IPTs were established in late 2004 to plan and own the execution of the corresponding NGATS strategies. These teams of government and private sector technical experts are applying best practices to achieve their assigned objects.

Current weather research efforts span four departments/agencies (FAA, NASA, NOAA and DOD) each tailored to its own mission. Synchronizing these missions will allow the JPDO to align the four agencies toward a common weather capability. By

updating existing weather information management standards, policies and data access/publication privileges, the NGATS will provide an integrated platform for weather decision systems. These efforts will harmonize agency programs aimed at the common objective of seamless integration of weather information. Moreover, it will eliminate duplication and save taxpayer dollars.

Q2. Through what mechanisms are the view of industry being incorporated in the JPDO planning process, and how well are those mechanisms working thus far? What, if anything, would you recommend be done to improve the interaction of industry with the JPDO planning process?

A2. The primary mechanism for incorporating the views of industry is through the NGATS Institute, which was established for the express purpose of ensuring the involvement of the private sector in the JPDO. Through this mechanism there are now 200 *pro bono* private sector participants on the JPDO IPTs. In addition, funded studies to support the definition of NGATS will begin shortly. This new form of collaboration is still in its early stages. Nevertheless, the Institute has surveyed their members to gain insights on where improvements can be made and we are in the process of establishing an action plan to address what we have learned.

Q3. Are there any technology transfer issues that need to be addressed? Will NASA, for example, support development activities to the point where industry will pick up advanced development needed for deployment of key technologies?

A3. Technology transfer is a critical issue for the JPDO. To achieve the goals of the NGATS initiative technology has to transition from research into operation. This means that as research matures there has to be an active, technical partnership between those performing the research and those involved in implementation of the technology. That partnership should be dynamic and include the validation of these technologies at various stages of the development. It should also be focused on ensuring that the technology can be implemented with an acceptable level of risk.

The JPDO has a profound interest in developing and facilitating this kind of partnership. Aggressive transfer of capabilities from research to testing and then implementation is a critical element in assuring the success of NGATS.

Questions submitted by Representative Jim Costa

Q1. Does the JPDO believe that the Next Generation Air Transportation System (NGATS) will be able to handle three times today's traffic if the Nation's major airports are not modernized as well?

A1. The JPDO believes that airports are part of the transformation effort. The JPDO assumes that new runway development will continue to occur where demand dictates. In addition, from an operations perspective, the JPDO is examining "super-density" operations at the Nation's most congested airports. This capability will increase throughput on individual runways and reduce or eliminate capacity-limiting dependencies between the set of runways at an airport. Super-density will also allow, at some airports, an additional runway to be built between existing parallel runways without any capacity-limiting dependency.

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Q3. Keeping in mind that nearly all of today's delays are due to severe weather, runway limitations, and over scheduling: Is it reasonable for us to believe that the billions of dollars the JPDO's proposals are sure to cost in the implementation of the NGATS will solve the delay problems we already face today?

A2, A3. In addressing the issue of weather NGATS focuses on several factors. First, in today's operational environment, low visibility conditions reduce the efficiency of flight operations leading to delays in the system. NGATS is focused on integrating several technologies and procedures to create an "equivalent visual" capability that would eliminate low visibility as an efficiency and delay problem in the system.

Second, the JPDO is pushing to integrate today's weather forecasting and dissemination systems into an integrated, network-based weather data system that would directly feed flight management automated systems. These systems would provide the most efficient, highest capacity routes around severe weather systems.

All of the changes that JPDO proposes will be validated through high-fidelity modeling and simulation and eventually through flight operational demonstrations to confirm that sufficient benefits will accrue to justify the investment. As a part of this effort, the JPDO will maintain objective metrics of capacity, cost, and safety.

Q4. What does the JPDO see as the most urgent problem that needs to be addressed in the near future, not 25 years down the road?

A4. The JPDO has generated its first draft of the detailed Operational Improvement Roadmap that lays out the transition from today to the NGATS end-state. In the near-term, critical infrastructure, such as cooperative surveillance and digital ground-to-air data communications need to be established to support 4D flight trajectories and higher capacity operations. In addition, the policies associated with a performance-based National Air Transportation System need to be established to ensure aircraft are capable of taking advantage of this infrastructure and associated services.

It is also critical that the research programs are established that ensure that the critical automation needed to achieve the full capacity benefits are available by the end of the next decade. In addition, safety and environmental research is also critical to ensure that safety and environmental compatibility keeps pace with the rise in operations.

ANSWERS TO POST-HEARING QUESTIONS

Responses by David A. Dobbs, Assistant Inspector General for Aviation and Special Program Audits, U.S. Department of Transportation

Questions submitted by Chairman Ken Calvert

Q1. Several witnesses stated that maintaining support for the JPDO from its participating agencies over the long-run was critical. What organizational and management changes, if any, do you recommend to enhance long-term support of the JPDO?

A1. Maintaining long-term support for JPDO by the participating agencies is critical to the success of NGATS, particularly given that the transition to the next generation systems will take years and the fact that FAA conducts little long-term air traffic management research. These are the reasons why we highlighted the importance of developing mechanisms for the alignment of agencies' budgets and plans related to JPDO efforts.

The most urgent management challenge focuses on filling the position of the JPDO director, which is currently vacant. This is important given that the JPDO has no authority to align diverse agency resources.

Another management challenge that will require attention is effectively linking the JPDO and the FAA's Air Traffic Organization (ATO). This linkage is important because the JPDO as currently structured is a planning organization. The ATO is responsible for managing modernization efforts, such as Automatic Dependent Surveillance—Broadcast (ADS–B) that is prominently highlighted in the JPDO's recent progress report.

Q2. What critical policy decisions must be made by the Senior Policy Committee before the JPDO can start down a particular technology and architecture path? For example, do decisions need to be made on the degree to which responsibility for aircraft can be handed over to automated systems, or whether some airplanes will be allowed to fly using "visual flight rules" instead of filing a flight plan, or how NGATS will treat commercial aviation vs. general aviation? What significant policy issues do you think fall into this category?

A2. There is no question that the JPDO must address policy questions as well as technology development. At this time, we see the Senior Policy Committee (SPC) focusing on issues that cut across agencies, such as research and development funding levels, making sure efforts are aligned, and larger questions about who ultimately pays for what elements of NGATS. The SPC will also likely be engaged on determining the appropriate back-up for satellite-based navigation systems, which is a very important matter.

The decisions about whether some responsibilities can be shifted from the controller to the pilot and treatment of various types of airspace users (i.e., passenger airlines and general aviation) will likely fall on FAA. The SPC will help shape these policy issues but the ultimate responsibility will likely be with FAA given that it is responsible for safety and managing the National Airspace System.

Q3. What are your views about the wisdom of having JPDO contract out much of the development work for NGATS to a lead systems integrator for NGATS? What are the advantages and disadvantages of bringing in a lead systems integrator for NGATS?

A3. There is considerable discussion in industry and FAA about contracting out development work for NGATS and whether or not a lead systems integrator will be needed. The central issue focuses on what will be done differently from past modernization efforts with NGATS initiatives (other than conducting demonstration projects) to ensure success and deliver much needed benefits to FAA and airspace users.

The JPDO and FAA face a wide range of risks, such as complex software development and complex systems integration and engineering challenges with NGATS initiatives (such as SWIM and ADS–B) and existing FAA projects. Another challenge will be synchronizing Government investments (new ground systems) and industry investments (new avionics) on an agreed to schedule.

To help manage the transition to the next generation system, FAA is considering whether or not a *lead systems integrator*—a private contractor that would help link new and existing systems and help manage other contractors—will be required. DOD has relied on this for complex weapon systems. Models for using a lead system integrator throughout the Government differ with respect to roles and responsibil-

ities. Questions about the role, responsibility, and expected costs of such an approach will need to be examined.

A lead system integrator is not a silver bullet for getting NGATS on line, and we see both advantages and disadvantages. Advantages focus on obtaining specialized expertise that helps to integrate diverse contractors, familiarity with current market solutions and potential off-the-shelf products and relieving the government from the burden of linking complex systems. However, there are disadvantages that have to be considered. For example, a lead systems integrator requires constant oversight to ensure that it has the Government's best interests in mind. Also, decisions need to be made whether or not intellectual property rights will remain the property of the Government, or will remain with the contractors.

Questions submitted by Representative Mark Udall

Q1. Would a requirement—enforced by OMB—that the agencies involved in the JPDO develop an annual, coordinated, cross-agency budget laying out the resource allocations by agency and by JPDO-defined goal make the JPDO planning process more credible and help overcome the intrinsic weakness of a JPDO that doesn't actually control budgets?

A1. The OMB can play an important role in aligning resources and help compensate for the fact that the JPDO has no authority to redirect agency resources. As stated in our testimony, alignment of budgets between agencies is critical for the long-term success of the JPDO. Indeed, JPDO recognizes that much work is needed to align agency budgets and to develop mechanisms that will sustain alignment over the long haul. JPDO is working with OMB to develop an integrated budget document that provides a single business case (a document similar to the "OMB Form 300") to make sure efforts are aligned. As part of this effort, JPDO has promised to provide OMB in the next several months with an enterprise architecture (an overall technical blueprint) for the next generation system, as well as a specific list of programs in other agency budgets it intends to leverage.

Q2. What do you consider to be the most important R&D challenges that will have to be overcome if the JPDO is to successfully deliver a Next General Air Transportation System?

A2. There are many important R&D challenges that must be overcome to make NGATS a reality. We discussed many of these challenges in our examination of the JPDO's integrated product teams which is detailed in our prepared statement. For example, it will be challenging to integrate up-to-date weather information into new planned automation efforts being developed by NASA for handling three times more traffic. Also, we highlighted a number of management challenges ranging from technology transfer to monitoring alignment over the long haul.

A very important challenge is making sure that the expected changes (for both pilots and controllers) envisioned by the JPDO can safely be accommodated. For example, the JPDO expects to automate a great deal of what a controller does today to ensure safe separation of aircraft. The Congress, FAA, and airspace users will need to know what functions can be automated and how such concepts as dynamic airspace management (flexible airspace sectors) can be implemented.

Q3. How well are the various agencies R&D programs aligned with the requirements of the NGATS? What will it take to ensure that the R&D programs are properly aligned?

A3. Thus far, our work on three of JPDO's Integrated Product Teams (e.g., Weather, Agile, and Shared Situational Awareness) shows that there is considerable coordination among the participating federal agencies but much work remains to align agency budgets and plans. Moreover, the IPT leads do not have the authority to commit agency (FAA) resources to JPDO efforts and often have no products other than plans.

We see the most potential for the most progress with coordination and alignment between JPDO and NASA. Even though NASA is restructuring its aeronautical research program and spending less than in the past, the JPDO and NASA are working together on several complex concepts for new automation systems and the timing of research projects. However, experience shows that NASA will need a much clearer picture of FAA's requirements—and when prototypes would be needed—to better support the next generation system.

To ensure that R&D programs are properly aligned, we believe that the JPDO needs to continue work with the Office of Management and Budget to develop an integrated budget document that provides a single business case and complete an

architecture for the next generation system. The JPDO also needs to generate a specific list of programs in other agency budgets it intends to leverage and provide that information to the Congress.

Q4. Is the current structure and authority of the JPDO adequate to meet the responsibilities given the Office to develop and implement the NGATS, and if not, what changes are needed? If you think changes are needed, how soon do they need to be made?

A4. As currently structured, the JPDO is a planning and coordination office-not an implementation or program execution office. FAA is responsible for operating the National Airspace System and the Agency's Air Traffic Organization (ATO) will be responsible for implementing JPDO initiatives. At this stage, the current structure of the JPDO is probably about right given the maturity of planning and architecture development. We do believe it will be important to establish connectivity between the JPDO and FAA's ATO as well as clear lines of accountability and responsibility between the two organizations.

Q5. What specific roles are human factors R&D and training playing in the design of the NGATS, and how important are they to the overall success of the NGATS? What do you think are the most important human factors issues to be addressed? NASA has lost a number of its human factors researchers in recent years—what impact will that have on the ability to address the key human factors issues associated with the NGATS?

A5. A sound understanding of the human factors issues associated with the NGATS is absolutely essential. Targeted human factors research and the development of new training regimes for controllers and pilots will be crucial to allow the system to handle three times more traffic. However, JPDO's detailing of specific requirements (through the enterprise architecture process) is critical in making sure human factors research is targeted on the most important areas.

The most important human factors issues with NGATS focus on how controllers and pilots will be integrated in a increasingly complex aviation system, and how functions can be allocated between human operators and automated systems. These changes will extend beyond the traditional computer-machine interface and have important workforce and safety implications. For example, FAA expects the controller's role to change from direct, tactical control of aircraft to one of overall traffic management. There are also significant human factors concerns for pilots, who will be expected to rely more on data link communications and satellite-based systems. This has implications for crew training and the positioning of cockpit displays on the flight deck.

We emphasized the need for focused human factors work because history has shown that insufficient attention to human factors can increase the cost of acquisition and delay much needed benefits. For example, problems in the late 1990s with FAA's *Standard Terminal Automation Replacement System* were directly traceable to not involving users early enough in the process. It will be important to have sufficient human factors analysis and studies to ensure that the changes envisioned by the JPDO can be safely accommodated.

As stated in our testimony, NASA is restructuring its aeronautics research program to place a greater emphasis on long-term research investments. Part of this restructuring involves the airspace systems program which is intended to develop the new automation systems envisioned by the JPDO. We have little insight into internal NASA operations but we have been told by NASA officials that human factors work will not suffer and work will be embedded in individual projects.

Q6. What is the relationship between FAA's Air Traffic Organization and the JPDO—is it sufficiently well defined?

A6. The relationship between the ATO and JPDO is evolving and clear lines of accountability and responsibility need to be established. Although the JPDO's progress report discusses new capabilities such as ADS–B and SWIM, the ATO is responsible for managing these efforts as well as establishing funding levels, schedule, and performance parameters.

In our written statement, we point out that ADS–B and SWIM are not yet integrated into ongoing communications and automation efforts but need to be. If the JPDO and ATO are not sufficiently linked and clear lines of accountability are not established, then cost and schedules for NGATS will not be reliable and expected benefits will be diminished or postponed.

We have shared our concerns about effectively linking the JPDO and ATO and establishing clear lines of accountability with the Chief Operating Officer and the Acting Director for ATO Planning. They recognize the need for close coordination

and are examining ways to better link the two organizations. One step that is underway is to adjust the *Operational Evolution Plan* (the Agency's capacity blueprint) to reflect JPDO efforts. This is an important watch item for the Congress as it tracks progress with NGATS.

Q7. Describe how and to what extent NOAA is involved in weather-related R&D needed to advance the NGATS.

A7. NOAA is involved in NGATS planning efforts, contributing about $2.5 million a year to support JPDO through the National Weather Service (NWS). JPDO plans call for a single, national weather observation and modeling database for current and predicted aviation weather.

The NWS has a long history of supporting aviation and working with FAA. In fact, Federal Aviation Regulations require pilots and dispatchers to consult NWS weather observations and forecasts for departure and arrival airports before beginning flight operations.

As we noted in our statement, the JPDO can take better advantage of NOAA efforts. Specifically, the Office of Atmospheric Research and the National Environmental Satellite Data and Information Service were not directly involved in JPDO efforts when we conducted our review. These agencies represent about a $1.1 billion annual investment in atmospheric science platforms and research skills that could be leveraged to meet the NGATS plan weather requirements. We have shared our concerns about more effectively leveraging NOAA efforts with the JPDO and it recognizes it can do a better job.

Q8. Through what mechanisms are the views of industry being incorporated in the JPDO planning process, and how well are those mechanisms working thus far? What, if anything, would you recommend be done to improve the interaction of industry with the JPDO planning process?

A8. The JPDO established the NGATS Institute in March 2005 specifically to allow for industry participation in shaping the next generation air traffic management system. Currently, industry representatives are participating in JPDO IPTs. For example, JPDOs progress report cited that over 140 industry and private sector participants (from 66 organizations) are involved in IPT planning efforts.

Industry has expressed concern that participation in JPDO activities might preclude them from bidding on future FAA acquisitions related to NGATS because it may create an organizational conflict of interest. Generally speaking, FAA's Acquisition Management System (AMS) precludes contractors from competing on production contracts if the contractor either participated in or materially influenced the drafting of specifications to be used in future acquisitions for production contracts, or had advanced knowledge of the requirements.

FAA is aware of industry's concern and is working to ensure that industry participation does not result in organizational conflicts of interest. JPDO officials believe—and we agree—that resolving this issue will be essential to get the desired skill and expertise from industry.

Q9. Are there any technology transfer issues that need to be addressed? Will NASA, for example, support development activities to the point where industry will pick up advanced development needed for deployment of key technologies?

A9. As stated in our testimony, technology transfer is a central issue for the JPDO because the law envisions new capabilities developed by other federal agencies (or the private sector) being transitioned into the National Airspace System. The JPDO will have to pay much greater attention to this matter to make sure industry can pick-up the advanced development needed to deliver new systems.

Our past work shows that FAA has experienced mixed success in transitioning systems developed by others into the National Airspace System. For example, FAA ultimately abandoned work on a new controller tool developed by NASA (the Passive Final Approach and Spacing Tool) for sequencing and assigning runways to aircraft because of complex software development and cost issues.

As we noted in our review of FAA's Free Flight Phase 1 Program, the use of "technology readiness levels" could be useful to help assess maturity of systems and ease issues associated with the transfer of technology. Both NASA and DOD have experience with categorizing technical maturity. This could help reduce cost, schedule, and technical risk with implementing JPDO initiatives.

Question submitted by Representative Sheila Jackson Lee

Q1. What is the reason for the lack of participation of the air traffic controllers in the activities of the JPDO, and what is the impact of their lack of participation?

A1. There are a number of reasons why the controllers union is not participating in JPDO activities. Here are the facts as we understand them.

In June 2005, FAA terminated its liaison program through which air traffic controllers had been assigned as liaisons to its major system acquisition program offices. This included the liaison assigned to JPDO. Since that time, NATCA has not been a participant in planning NGATS.

Although the NGATS Institute Management Council includes a seat for the union, a NATCA official told us that the union's head had been unable to attend the council's meetings. According to JPDO officials, the council has left a seat open in hopes that the controllers will participate in NGATS.

Currently, the absence of NATCA on the JPDO has had minimal impact on the NGATS. The JPDO is currently relying on former controllers to help define human factors issues. However, further down the road, especially when focused human factors work is needed, the lack of participation by NATCA could seriously hamper completion of the required work.

Questions submitted by Representative Jim Costa

Q1. Does the JPDO believe that the Next Generation Air Transportation System (NGATS) will be able to handle three times today's traffic if the Nation's major airports are not modernized as well?

A1. Without question, continued airport investments will be essential to meet the forecasted demand for air travel. In fact, the JPDO has one IPT focused specifically on airports. Also, NGATS as envisioned by the JPDO takes other FAA plans such as the "Flight Plan" and "Operational Evolution Plan" into consideration. Both plans emphasize the importance of continued airport development. The major thrust of NGATS is to use a combination of things—new automation, new procedures, better weather information, and advanced avionics—to meet the anticipated demand for air travel. We note that non-hub airports are also expected to play an important role in enhancing capacity.

Q2. How will the NGATS be able to mitigate the impact severe weather has on the system?

A2. A key element of NGATS is mitigating the impact of severe weather on the National Airspace System. JPDO plans call for visual flight rules operations even in instrument meteorological conditions, and adjusting traffic flows quickly to avoid weather hazards like microbursts, thunder storms, and pockets of severe air turbulence. In short, the NGATS plan envisions the future system operating like a good weather day regardless of the weather conditions.

JPDO plans call for mitigating the impact of bad weather in two ways. First, the JPDO intends to increase situational awareness among all airspace users by providing a common, shared picture of aviation weather and air traffic conditions through a net-centric system, known as the System Wide Information Management System (SWIM). At some point in the future, the JPDO envisions that aircraft will become nodes on a network and exchange weather information with ground based computers.

Second, the JPDO plans call for automating flight planning and flight tracking to allow for flexible flight paths (called "conflict free trajectories") that incorporate current and predicted weather patterns to avoid weather hazards. This is expected to allow for more flexible routing of air traffic than today's system can accommodate.

Q3. Keeping in mind that nearly all of today's delays are due to severe weather, runway limitations, and over scheduling: Is it reasonable for us to believe that the billions of dollars the JPDOs proposals are sure to cost in the implementation of the NGATS will solve the delay problems we already face today?

A3. While it is reasonable to believe that JPDO initiatives will help mitigate delays, it is hard to imagine that they can be totally eliminated. The goals set by the JPDO to handle three times more traffic and reduce delays are ambitious but needed. Consequently, there is almost universal agreement that changes are needed in the current system (or business as usual) to boost capacity, reduce delays, and help reduce FAA's cost of providing services.

As we have noted in the past, the delay problem is a result of many factors, including airline scheduling, airspace constraints, runway limitations, and bad weather. While new runways and better technology will help, there may be some airports where adding additional capacity to meet demand is not an option. This is why we have called on the DOT and FAA to examine market-based solutions where adding additional capacity is not an option. A case in point is LaGuardia Airport. This is

one reason why the JPDO must address policy questions as well as technology development issues to address the delay issue.

Today, weather causes about of 70 percent of all air traffic delays. Because of the interconnectivity of the National Airspace System, bad weather in one location can have a ripple effect nationwide. The JPDO's focus on getting much better weather information than we have today to all airspace users and linking new automation systems with up-to-date weather data offer significant potential to reduce delays.

It is difficult, if not impossible, to determine if JPDO plans will be cost effective in meeting the delay problem because of the large number of unknowns. For example, it is unclear how much NGATS will cost. Further, work remains to link the policies, procedures, and airspace changes needed to get the full benefits of NGATS initiatives. It will be important for FAA and the JPDO to analyze and identify the costs and benefits from NGATS initiatives to ensure that the anticipated changes have the desired impact on reducing delays at a reasonable cost.

Q4. What does the JPDO see as the most urgent problem that needs to be addressed in the near future, not 25 years down the road?

A4. We cannot speak for the JPDO, but we see the main problems facing FAA in the near-term as enhancing capacity, reducing delays, boosting controller productivity, and controlling operating costs. To accomplish this, we believe that there are several areas that need attention by FAA as well as the JPDO, specifically:

- Leadership. The position of the JPDO Director is currently vacant—FAA needs to find the right person to lead this effort.
- Establishing connectivity between JPDO plans and Air Traffic Organization (ATO) efforts. This is important because the JPDO, as currently structured, is a planning and coordinating organization—not an implementation or program-execution office.
- Develop the NGATS enterprise architecture and a roadmap for implementation. The Congress and aviation community need a clear understanding of requirements and expected benefits in five-year intervals. This is particularly important of airspace users who will be expected to equip with new avionics.
- Developing and implementing mechanisms for alignment. There is considerable coordination among JPDO participating agencies but little alignment of budgets and plans. There is a need for mechanisms to help the JPDO align diverse agency efforts over the long haul.

ANSWERS TO POST-HEARING QUESTIONS

Responses by S. Michael Hudson, Chairman, Committee on Technology Pathways, Division on Engineering and Physical Sciences, National Research Council, The National Academies

Questions submitted by Representative Mark Udall

Q1. Would a requirement—enforced by OMB—that the agencies involved in the JPDO develop an annual, coordinated, cross-agency budget laying out the resource allocations by agency and by JPDO-defined goal make the JPDO planning process more credible and help overcome the intrinsic weakness of a JPDO that doesn't actually control budgets?

A1. Our report did not consider specific funding scenarios. The committee did feel that the most important aspect of the budget is stability. Funding uncertainty makes it difficult to develop and carry through on long-term plans and commitments.

My personal opinion is that large systems, as seen in many multi-service defense projects, require strong, central funding coordination and strong leadership to enforce funding agreements.

Q2. What do you consider to be the most important R&D challenges that will have to be overcome if the JPDO is to successfully deliver a Next Generation Air Transportation System?

A2. From the Technology Pathways Report:

"In general, new technologies and processes should be tailored to meet the needs of validated operational concepts, but some are certain to be of value regardless of the operational concepts ultimately selected, and their development should proceed even as the operational concepts are being defined and assessed. Examples of these generally applicable technologies and processes are as follows:

- *Automation technologies applicable to fully automated systems; decision aids; and information systems for communication, visualization, situation assessment, and the prediction of future conditions.*
- *Technologies that support distributed, collaborative decision-making and foster coordination and interactions among multiple human and automated elements of the system.*
- *Methods and technologies for moderating and abating the impact of noise and emissions locally, regionally, and globally.*
- *Methods and technologies for predicting or directly sensing the magnitude, duration, and location of wake vortices, to support the goal of reducing separation standards without compromising safety.*
- *Methods for identifying (1) the information required for situation awareness when humans are assigned novel (untried) tasks in future operational concepts and (2) sensor, computing, and display technologies for better supporting situation awareness, judgment, decision-making, and planning. Relevant technologies may include synthetic vision, cockpit and controller displays for novel ATM functions, fast-time simulation and computational functions for predicting future conditions, and alerting systems. These methods and technologies should be investigated for their potential to (1) reduce separation standards without compromising safety and (2) enable changes in the roles of humans within the system.*
- *Systems-engineering methods that are (1) capable of conceiving and analyzing systems as complex as the air transportation system and (2) suitable for governing the design, testing, and implementation of these systems.*
- *Avionics technologies that will provide ubiquitous and transparent communication, navigation, and surveillance capabilities; enable cost-effective, reliable ATM; and contribute to the reduction of separation standards without compromising safety."*

Among these, technologies relating to automation and human factors are especially important.

In addition, it is critical that research be advanced to the necessary level of maturity. When technology is transitioned to the private sector, industry itself will further developed it into a usable product. However, this is not the case when it is

transferred from a research-focused federal agency (such as NASA) to one focused on operations (such as the FAA). The FAA needs fully matured technology that it can put directly into use. Otherwise, it may fall by the wayside.

Q3. How well are the various agencies' R&D programs aligned with the requirements of the NGATS? What will it take to ensure that the R&D programs are properly aligned?

A3. At the time our report was written, the agencies were still establishing their research programs. However, there was already concern that some of the proposed reductions in NASA's aeronautics budget (especially with regard to environmental research) were not consistent with the JPDO's research goals and would threaten the ability of the JPDO to develop NGATS as described in the Integrated Plan. One of the recommendations of our report was that "the members of the Senior Policy Committee should ensure that the federal agencies they direct or represent allocate funding and staff to (1) provide the JPDO with the resources it needs to define the Next Generation Air Transportation System and draw up an appropriate implementation plan and (2) ensure departmental and agency research in civil aeronautics is consistent with JPDO plans to enable and implement new operational concepts."

Q4. Is the current structure and authority of the JPDO adequate to meet the responsibilities given the Office to develop and implement the NGATS, and if not, what changes are needed? If you think changes are needed, how soon do they need to be made?

A4. From the report:

"Finding 4–1. IPT Organization. Even though the current IPTs have multi-agency membership, they are functioning primarily as experts in specific disciplines rather than as cross-functional, integrated, multi-disciplinary teams that can deliver specific products to improve operational capabilities of the air transportation system.

Recommendation 4–1. IPT Organization. As soon as possible, the JPDO's IPT organization should be modified to better support the core goal of meeting increased demand in each phase of operation by structuring the IPT organization to match the structure recommended for the operational concepts. All of the current IPTs (except for the Master IPT) should be disbanded and replaced with three new IPTs:

- *Airport Operations IPT*
- *Terminal Area Operations IPT*
- *En route and Oceanic Operations IPT"*

Q5. What specific roles are human factors R&D and training playing in the design of the NGATS, and how important are they to the overall success of the NGATS?

What do you think are the most important human factors issues to be addressed?

NASA has lost a number of its human factors researchers in recent years—what impact will that have on the ability of the JPDO to address the key human factors issues associated with the NGATS?

A5. The committee felt that human factors research was very important to the NGATS. From the report:

"[H]uman factors should be incorporated into the operational concepts and the restructured IPTs from the beginning. This would ensure, for example, that the tasks assigned to pilots, controllers, and other system operators are reasonable and appropriate, that interfaces with automated systems are well conceived and executed, and that efforts to improve situational awareness are likely to succeed. System designers must resist the temptation to provide more automated features and give more information to system operators just because they can; more automation does not always increase safety or reliability, and more information does not always improve situational awareness or operational decisions."

The loss of NASA researchers was not addressed at the time of our report.

My personal opinion is that NASA should maintain a strong and internationally recognized cadre of experts in this important field.

Q6. What is the relationship between FAA's Air Traffic Organization and the JPDO—is it sufficiently well defined?

A6. The committee felt that the secretary of transportation and the FAA administrator should take a more direct role in the JPDO. Since the ATO deals with day-to-day operation, it will be difficult for it to build a new concept that looks to the future while having to maintain a concentrated focus on today's issues.

Q7. Through what mechanisms are the views of industry being incorporated in the JPDO planning process, and how well are those mechanisms working thus far? What, if anything, would you recommend be done to improve the interaction of industry with the JPDO planning process?

A7. The Committee hosted a Workshop for the JPDO early in the review process that provided an overview briefing of the plan and included industry comments which provided some industry assessment of the plan.

At the time the report was written, the committee had concerns that Europe seemed to be far ahead of the U.S. in terms of engaging industry. From the report:

> *"Government-industry cooperation has been more effective [in Europe] than in the United States, in part because it is so difficult for U.S. airlines and other important stakeholders to reach consensus on key issues. Moving forward will be very difficult in the United States without a process that (1) fairly balances the need to create an air transportation system that can meet future demand while avoiding undue hardship for any particular element of the air transportation system and (2) ensures that changes endorsed by a majority of the U.S. air transportation community acting in the national interest cannot be thwarted by the opposition of a vocal minority acting out of self-interest without due regard for national interest."*

Since then, the NGATS Institute has been established specifically to engage the private sector. Because it did not exist at the time of our review, we are unable to comment on its effectiveness.

Q8. Are there any technology transfer issues that need to be addressed? Will NASA, for example, support development activities to the point where industry will pick up advanced development needed for deployment of key technologies?

A8. As stated in the report:

> *"In some research and technology areas described in the report, the state of the art is so advanced that industry could quickly begin product development. In other areas, basic research is needed to acquire necessary knowledge and technological capabilities. In each area of planned research, the gap between the status of current technology and the status envisioned by NGATS should be understood and a plan developed to bridge that gap. In some areas, this could be a substantial problem, given the well-documented problem that basic research programs often do not mature promising new technologies to the point where managers in industry are ready and willing to take over responsibility for advanced research and product development. This can also be a problem when transitioning technology from a federal agency focused on research (such as NASA) to another federal agency focused on operations (such as the FAA). The IPTs should develop a transition plan with clear criteria defining states of technological readiness for each technology that may encounter this problem."*

Also see the response to Question 2 above for further comments on technology transition.

Questions submitted by Representative Jim Costa

Q1. Does the JPDO believe that the Next Generation Air Transportation System (NGATS) will be able to handle three times today's traffic if the Nation's major airports are not modernized as well?

A1. The JPDO has established plans for airport modernization, which focus on infrastructure improvements and expansion. From our report:

> *"The Integrated Plan's transformation strategy for airports is titled 'Develop Airport Infrastructure to Meet Future Demand.' This title expresses both the goal (enable airports to meet future demand) and the approach (develop new infrastructure). As described in the Integrated Plan, the associated Airport Infrastructure IPT will focus on infrastructure improvements and expansion of airports. By omission, these plans seem to discount the ability to increase the capacity of existing airports by procedural changes such as those enabled by (1) the timely dissemination of precise information related to the position and velocity of aircraft, adverse weather, wake vortices, and the state of the air transportation sys-*

tem and (2) aircraft and ground facilities equipped to use this information effectively. Building new airports and new runways (especially if current procedural constraints on separation standards between parallel runways do not allow new runways to fit on existing airport property) is extraordinarily expensive and can take decades to complete. And in many areas, land for airport expansions and new airports is simply unavailable. Environmental issues also limit the ability of airports to expand their infrastructure. During the 1990s, environmental issues forced 12 of the Nation's 50 busiest commercial airports to cancel or indefinitely postpone expansion projects (GAO, 2000). Thus, solutions that substantially increase the capacity of existing runways are potentially quite advantageous. Large payoffs would also result from the ability to conduct independent flight operations on closely spaced parallel runways in limited visibility using the performance-based area navigation and flight management capabilities in many existing aircraft.

Eighteen of the Nation's 35 busiest airports are already at capacity limits or will reach capacity limits sometime in the next 15 years (FAA, 2004). One aspect of the effort to enable airports to meet higher demand might be to conduct an airport-specific analysis of impediments to higher capacity at these airports. The analysis would investigate solutions that are (1) generally applicable or (2) must be tailored to individual airports. The latter will tend to be more expensive than the former, on a per airport basis, but both types of solutions should be considered. In general, the most effective solutions are likely to involve an integrated approach that involves aircraft and ATM technologies, procedures, and standards, including those related to required navigation performance (RNP) and area navigation (RNAV) capabilities."

In addition, microjets and air taxis represent a wildcard—although they are currently speculative at best, if they were to become a significant portion of the air transportation system, they would have a huge impact on regular airports, as well as small, regional ones.

Q2. How will the NGATS be able to mitigate the impact severe weather has on the system?

A2. It is not likely that the NGATS will enable aircraft to fly through severe weather such as thunderstorms. However, increased sensors and avionics will be able to increase visibility in inclement conditions. Better weather monitoring and prediction will give earlier, more accurate, notice of severe weather systems. System-level monitoring and decision-making aids will enable more agile operations, reducing delays.

Q3. Keeping in mind that nearly all of today's delays are due to severe weather, runway limitations, and over scheduling: Is it reasonable for us to believe that the billions of dollars the JPDO's proposals are sure to cost in the implementation of the NGATS will solve the delay problems we already face today?

A3. The goal of the JPDO is not to solve today's delay problems, but to prevent the systems from being crippled by delays as demand for air travel increases. From our report:

"Meeting increased demand is difficult because capacity must be increased while also satisfying enabling, interrelated requirements related to safety, security, environmental protection, consumer satisfaction, and industrial competitiveness. The difficulty of meeting performance goals in each of these other areas would be mitigated if demand were stagnant or declining, but it will be exacerbated if demand increases substantially, as it is projected to do. In other words, improvements in virtually every aspect of the air transportation system are required to meet a substantial increase in demand. Accordingly, the highest priority should be given to research and technology development that is most likely to facilitate large increases in capacity (in terms of passenger miles and cargo ton miles), especially for airspace and airports that are currently at or near capacity limits."

Q4. What does the JPDO see as the most urgent problem that needs to be addressed in the near future, not 25 years down the road?

A4. Based on the organization of its Integrated Plan, Chapter 1 of which is titled "Change is Needed," we would say that the JPDO sees "change" as its most urgent priority.

The committee felt that,

"The Integrated Plan should clearly state that increased demand is the key driver that mandates implementation of the Next Generation Air Transportation Sys-

tem. The JPDO should refocus its efforts on development of a systematic, risk-based approach for achieving the primary objective, which is to resolve demand issues and increase capacity, while also satisfying enabling, interrelated requirements for safety, security, environmental effects, consumer satisfaction, and industrial competitiveness. The Integrated Plan should make sure that secondary objectives, such as alignment of existing interagency efforts, do not overshadow the primary objective. The JPDO should establish goals related to cost, schedule, and level of performance that can be quantified using appropriate figures of merit. Multiple candidate scenarios and operational concepts should be defined and assessed in terms of the risk that they will fail to achieve these goals."

ANSWERS TO POST-HEARING QUESTIONS

Responses by Gerald L. Dillingham, Director, Physical Infrastructure Issues, Government Accountability Office

Questions submitted by Chairman Ken Calvert

Q1. Several witnesses stated that maintaining support for JPDO from its participating agencies over the long-run was critical. What organizational and management changes, if any, do you recommend to enhance long-term support of JPDO?

A1. To date, the Joint Planning and Development Office's (JPDO) current organizational structure appears to facilitate the federal interagency collaboration that is central to JPDO's mission. However, as the transition to the next generation air transportation system (NGATS) moves forward, the volume and complexity of the tasks will increase. Consequently, it is important for JPDO to define and institutionalize the roles and responsibilities of its partner agencies to ensure the long-term support for planning and implementing NGATS. The institutionalization of roles and responsibilities is especially important since the NGATS effort will extend through eventual changes in agency and JPDO leadership. Currently, there is no formal, long-term agreement on the partner agencies' roles and responsibilities in creating NGATS. According to JPDO officials, a memorandum of understanding that would define the partner agencies' relationships was being developed as of August 2005, but has not yet been completed.

Also important to enhancing the long-term support of JPDO are steps to integrate the NGATS goals into partner agencies' budget processes. Currently, JPDO is working with the Office of Management and Budget (OMB) to establish a process for identifying the NGATS as a unified program. We believe that this is a good first step to ensure that NGATS moves ahead in a coordinated, coherent manner.

In addition, one mechanism for enhancing and sustaining federal collaborations is to use agencies' strategic and annual performance plans as tools for establishing complementary goals and strategies. However, based on our initial assessment of the partner agencies' strategic plans, we found that only the Department of Transportation (DOT), the National Aeronautics and Space Administration (NASA), and the Federal Aviation Administration (FAA) have incorporated the NGATS goals into their agency-level strategic plans. Although we have not completed our review of the partner agencies' strategic plans, including the National Oceanic and Atmospheric Administration's (NOAA) strategic plan, more opportunities exist for integrating the NGATS goals into the partner agencies' plans and budgets. For example, only NASA's current reauthorization act requires the agency to align its aviation research projects to directly support the NGATS goals. This type of congressional action can reinforce accountability for the JPDO collaboration by aligning agency goals and strategies with those of NGATS and further institutionalize the NGATS goals into the partner agencies' plans.

Q2. What critical policy decisions must be made by the Senior Policy Committee before the JPDO can start down a particular technology and architecture path? For example, do decisions need to be made on the degree to which responsibility for aircraft can be handed over to automated systems, or whether some airplanes will be allowed to fly using "Visual Flight Rules" instead of filing a flight plan, or how NGATS will treat commercial aviation vs. general aviation? What significant policy issues do you think fall into this category?

A2. Before the JPDO can start down a particular technology and architecture path, the Senior Policy Committee (the Committee) must first approve the budget guidance that the JPDO provides to the partner agencies. That document recommends specific research initiatives, technologies, and schedules for implementation and deployment. For fiscal year 2007, the JPDO's Integrated Product Teams (IPT) identified a number of "Jump Start" initiatives, including putting Automatic Dependent Surveillance–Broadcast (ADS–B) and System Wide Information Management (SWIM) on the fast track. These initiatives were included in agency budget guidance that was approved by the Committee. In the future, such decisions will flow from the enterprise architecture. JPDO plans to have an early version of the enterprise architecture available by the end of this fiscal year, with significant IPT input.

The policy decisions suggested in the question above are among those that the Committee could decide. For example, the Committee could address policy issues surrounding how roles and responsibilities for handling increased traffic may shift as a result of the increased reliance on automation envisioned in NGATS. Con-

cerning general aviation, JPDO officials noted that NGATS has the potential to provide significant benefits to this community. However, they said that it is difficult to specify exactly what decisions the Committee would have to make concerning general aviation. Officials said that most of these decisions, when they occur, will be tied to the requirements of the enterprise architecture. In any event, it is likely that decisions on concepts and policies relating to general aviation would be made in concert among JPDO, the Committee, and FAA to address concerns such as visual flight rules vs. instrument flight rules. New technologies would require testing or demonstrating for use in the national airspace system (NAS). Also, FAA would have to start developing the regulation for implementation at the appropriate point so that the regulation would be available at the appropriate time.

Q3. What are your views about the wisdom of having JPDO contract out much of the development work for NGATS to a lead systems integrator? What are the advantages and disadvantages of bringing in a lead systems integrator for NGATS?

A3. Determining whether using a lead systems integrator (LSI) would be advantageous or disadvantageous in planning NGATS depends on a number of considerations. According to criteria developed by the National Academies, Committee on Systems Integration for Project Constellation, using an LSI could:

- provide better systems integration knowledge, experience, and capabilities;
- recruit more talented personnel and manage complex organizational and international relationships;
- better identify and obtain advanced technologies from many sources;
- provide more experienced and disciplined project management experience; and
- bring greater credibility (public and political) to the project.

Determining whether the use of an LSI is the most efficient and effective way to achieve these goals for NGATS should be a major consideration in JPDO's decision whether to engage an LSI. However, our work has shown that using an LSI does not guarantee success. For example, the Department of the Army (Army) has used an LSI for the Future Combat Systems because the program was the most significant technology and integration challenge that it had ever undertaken. Because of the complexity of this program, the lack of knowledgeable personnel, and the need for more management and acquisitions flexibility than could be obtained through normal contracting procedures, the Army selected an LSI. However, we reported that the program was behind schedule and over budget despite its use of an LSI.

Questions submitted by Representative Mark Udall

Q1. Would a requirement—enforced by OMB—that the agencies involved in the JPDO develop an annual, coordinated, cross-agency budget laying out the resource allocations by agency and by JPDO-defined goal make the JPDO planning process more credible and help overcome the intrinsic weakness of a JPDO that doesn't actually control budgets?

A1. Yes, we believe that an annual, coordinated, cross-agency budget request would be beneficial in trying to realize the goals of JPDO. We have previously stated that JPDO faces a challenge in leveraging resources among its partner agencies because JPDO is fundamentally a planning and coordinating body that lacks authority over the key human and financial resources needed to continue developing plans for NGATS.

JPDO is currently working with OMB to develop a systematic means of reviewing the partner agency budget requests so that NGATS-related funding in each is easily identified. We plan to further explore these budgetary issues with JPDO and OMB as part of our ongoing work, and to report our findings later this year.

Q2. What do you consider to be the most important R&D challenges that will have to be overcome if the JPDO is to successfully deliver a Next Generation Air Transportation System?

A2. Identifying important research and development (R&D) challenges will depend to some extent on the development of the NGATS enterprise architecture. However, it is already known that one important R&D challenge that must be overcome to deliver NGATS is to fully understand and address the human factors challenges associated with automation. For example, using automation raises questions about the extent to which the system will be automated and whether controllers will have the

ability to accept or reject automated commands. Additionally, the human factors issues related to changing the workload of air traffic controllers and pilots is critically important because NGATS envisions a shift of some of a controller's workload to pilots. Although JPDO has begun to model how shifts in air traffic controllers' workloads would affect their performance, it has not yet begun to model the effect of how this shift in workload to pilots would affect pilot performance. According to a JPDO official, modeling the effect of changes in pilot workload has not yet begun because JPDO has not yet identified a suitable model for incorporation into its suite of modeling tools.

Another important challenge facing JPDO's delivery of NGATS will be obtaining the resources necessary to complete the R&D of technologies that NASA has initiated. With NASA's new focus on fundamental aeronautics research, the agency does not intend to develop technology to the level that it did in the past. JPDO will have to fill this gap by leveraging the resources necessary to further develop, validate, and demonstrate these technologies. We plan to explore how NASA's new focus on fundamental aeronautics research will impact the transition to NGATS as part of our ongoing work.

Q3. How well are the various agencies' R&D programs aligned with the requirements of the NGATS? What will it take to ensure that the R&D programs are properly aligned?

A3. For alignment of R&D programs with the needs of NGATS, JPDO must identify the R&D projects across partner agencies that support NGATS and encourage the agencies to fund and develop these projects. These efforts are already under way, as JPDO is examining the partner agencies' R&D programs to see if they are consistent with NGATS goals. As part of these efforts, JPDO has identified five early opportunities—R&D programs in the fiscal year 2007 budget that it can focus on immediately. These programs include network-enabled operations to strengthen national security, cooperative surveillance via ADS–B to increase security and safety, the development of SWIM, defining NGATS Required Total System Performance (RTSP), and aligning levels of service to match RTSP.

The NGATS enterprise architecture, when completed, will be a key tool that helps partner agencies align their R&D programs. Because it will provide a blueprint for NGATS, partner agencies will better understand what R&D is needed to allow their systems to interact with those of other partner agencies in meeting the goals of NGATS. It will also help private sector manufacturers align their R&D activities to support NGATS.

Q4. Is the current structure and authority of the JPDO adequate to meet the responsibilities given the Office to develop and implement the NGATS, and if not, what changes are needed? If you think changes are needed, how soon do they need to be made?

A4. To date, JPDO's current organizational structure appears to facilitate the federal interagency collaboration that is central to JPDO's mission. However, JPDO is fundamentally a planning and coordinating body that lacks authority over the key human and technological resources needed to continue developing plans and system requirements for NGATS. Consequently, the ability to continue leveraging resources of its partner agencies will be critical to JPDO's success, especially as partner agencies' will need to commit more resources for further refining and implementing NGATS.

Under its current structure, JPDO has begun taking critical steps to achieve its mission and align the resources of its partner agencies. These steps include efforts to identify opportunities for coordinating and leveraging partner agencies' research and development efforts, using staff from the partner agencies to support JPDO work, and begin aligning its partner agencies' budgets to support the NGATS. However, JPDO could be doing more under its current structure. For example, the institutionalization of roles and responsibilities is especially important since the NGATS effort will extend through eventual changes in agency and JPDO leadership. However, there is no formal, long-term agreement on the partner agencies' roles and responsibilities in creating NGATS.

As JPDO continues to evolve and mature as an organization, changes to JPDO's authority and structure will need to be continuously evaluated and considered. Officials and stakeholders have suggested several options for changing the structure and authority of JPDO. These options include:

- making JPDO a program office with its own budget;
- elevating the position of the JPDO director within FAA or DOT;
- using an LSI; or

- adding a legislative requirement for partner agencies to align their research projects with the NGATS goals.

For example, NASA's current reauthorization act requires the agency to align its aviation research projects to directly support the NGATS goals. This type of congressional action can reinforce accountability for the JPDO collaboration by aligning agency goals and strategies with those of the NGATS and further institutionalize the NGATS goals into partner agencies' plans. However, before changes are made to JPDO's structure and authority, the pros and cons of each of these options should be evaluated.

Q5. What specific roles are human factors R&D and training playing in the design of the NGATS, and how important are they to the overall success of the NGATS?

A5. JPDO officials have recognized the importance of human factors considerations for R&D and have indicated their intention to apply human factors throughout the planning and development phases of NGATS. For example, as part of the planning for NGATS, JPDO has used modeling to study how changes in the duties of air traffic controllers could affect the workload and performance of other airport ground personnel. The human factors issues related to shifting some workload from air traffic controllers to pilots is also critically important. However, JPDO has not yet begun to model the effect of this shift on pilot performance because, according to a JPDO official, the office has not yet identified a suitable model for incorporation into its suite of modeling tools.

JPDO also intends to study the human factors implications of training air traffic controllers. A JPDO official said that they have not yet begun to assess these implications because the enterprise architecture—a blueprint for NGATS which will indicate the technologies to be used—is still being prepared. However, the transition from the current NAS to NGATS could affect training. For example, according to a JPDO official, it is anticipated that, during the transition period, controllers will have to be cross-trained on both the equipment being replaced as well as the NGATS equipment, resulting in increased training costs.

JPDO officials have also indicated that they anticipate using human factors considerations to plan and validate the operational concepts during the research and development phase that have been identified for NGATS. Human factors considerations include the development of scenarios to use for testing new equipment as well as to explore training needs of aviation personnel.

Q5a. What do you think are the most important human factors issues to be addressed?

A5a. While JPDO officials have identified some important human factors issues to date, additional important human factors issues include how new procedures and technologies are introduced to controllers; what techniques are used to train controllers; what support equipment, such as simulators, can be introduced to aid controller training; and whether various controller functions should be replaced by automation or remain manual with some automated actions that support the controller.

Q5b. NASA has lost a number of its human factors researchers in recent years—what impact will that have on the ability of the JPDO to address the key human factors issues associated with the NGATS?

A5b. We have not yet examined the contributions of NASA researchers to JPDO's efforts on human factors. We plan to explore this issue and include our findings in our report on JPDO to be released later this year.

Q6. What is the relationship between FAA's Air Traffic Organization and the JPDO—is it sufficiently well defined?

A6. FAA's Air Traffic Organization (ATO) has responsibility for operating, maintaining, and modernizing the current air traffic control system. JPDO is responsible for planning and coordinating the broader, longer-term transformation to NGATS. The formal relationship is that JPDO reports to ATO's Chief Operating Officer for day-to-day management oversight and to FAA's Administrator for national direction. At present, this relationship is in the process of maturing. Within the last year, ATO has reportedly modified its modernization plans to represent the FAA portion of JPDO's plan for NGATS. This is a positive development.

Our work has shown that collaborating agencies should work together to define and agree on the respective roles and responsibilities, including how the collaborative effort will be led. In JPDO's case, there is no formalized long-term agreement with any of the partner agencies, including FAA, on their roles and responsibilities

in creating NGATS. According to JPDO officials, a memorandum of understanding that would define partner agency relationships was being developed as of August 2005, but has not yet been completed.

Further definition of the roles and responsibilities between ATO and JPDO will be particularly important, since both organizations have responsibilities related to planning NAS modernization. JPDO's planning must build upon the ATO's existing modernization program, while the ATO must ensure that its ongoing modernization efforts are consistent with JPDO's plans. ATO faces a challenge in funding the current system to keep it up and running on a 24/7 basis while funding the transition to NGATS.

JPDO's former director served concurrently as the ATO's Vice President for Operations Planning, which helped with coordination between the two organizations. However, FAA now plans to establish separate positions for the JPDO Director and the ATO Vice President for Operations Planning. Doing so increases the importance of establishing a clearly defined relationship between these organizations.

Q7. Through what mechanisms are the views of industry being incorporated in the JPDO planning process, and how well are those mechanisms working thus far? What, if anything, would you recommend be done to improve the interaction of industry with the JPDO planning process?

A7. JPDO's mechanism for incorporating industry's views into the planning process is the NGATS Institute (the Institute). The Institute was created within a non-profit arm of the Aerospace Industries Association. Its mission is to facilitate the participation of experts from the private sector, academia, and State and local governments with the JPDO, and to conduct special studies. To date, the Institute has placed 197 experts on the IPTs.

The Institute is governed by a 16-member Institute Management Council (IMC), which is broadly representative of the aviation stakeholder community. The IMC's co-chairs, for example, are from the Air Line Pilots Association (which represents commercial pilots) and the Air Transport Association (which represents major commercial airlines). Other members are from regional airline operations, business aircraft operations, helicopter operations, and other aviation-related entities. The Institute held its first public meeting on March 28, 2006, in Washington, D.C. IMC board members and JPDO officials answered questions from attendees and discussed NGATS challenges.

The Institute is also holding a series of investment analysis workshops to collect information from industry to provide input on NGATS programs, costs, sequence, and schedule. The first workshop, in April 2006, was for members of the commercial and business aviation community. In May or June, a second workshop is planned for general aviation, military, and public safety sectors. A third workshop is planned for early July for airports and state and regional aviation groups. JPDO plans to spend six months working with participants from the three workshops to refine its cost estimates.

JPDO could improve the interaction of the aviation industry in its planning process by incorporating greater industry input into JPDO's four divisions—Enterprise Architecture, Enterprise Engineering and Integration, Portfolio Management, and Evaluation and Analysis. This could include seeking the expertise of industry experts to work collaboratively to develop the operational concepts and performance requirements that will make up JPDO's enterprise architecture. In addition, we believe that producing tangible benefits early on will be a key factor in sustaining the involvement of industry stakeholders.

Q8. Are there any technology transfer issues that need to be addressed? Will NASA, for example, support development activities to the point where industry will pick up advanced development needed for deployment of key technologies?

A8. NASA does not plan to support technology development to the point where industry is willing to step in. NASA plans to focus on fundamental research and then turn work over to FAA for further development. While a NASA official noted that developing technology to higher levels before industry picks it up does not necessarily guarantee success, a draft report from FAA's Research, Engineering, and Development Advisory Committee (REDAC) points out that placing a greater reliance on FAA to perform the further R&D (heretofore performed by NASA) would require FAA to establish the infrastructure needed to perform this work. REDAC concluded that such developments would delay NGATS implementation—probably by five years. Participants at JPDO's recent NGATS Investment Analysis Workshop, which included representatives from commercial airlines, business aviation, and aviation equipment supply industry, said that industry has no interest in filling this gap due to the risk and lack of profit opportunity. We are currently evaluating

whether NASA's reorientation of its aeronautics program to fundamental research leaves a gap in the technology transfer process.

Question submitted by Representative Sheila Jackson Lee

Q1. What is the reason for the lack of participation of the air traffic controllers in the activities of the JPDO, and what is the impact of their lack of participation?

A1. Our research showed that the National Air Traffic Controllers Association (NATCA) initially assigned a controller to JPDO as part of its liaison program with the FAA. On June 28, 2005, FAA notified NATCA that it was terminating the liaison assignments effective July 29, 2005, citing budget constraints and the implementation of the ATO. The controller who had been acting as the liaison within JPDO's Agile Air Traffic System IPT was among the controllers who returned to his facility. Since that time, no active controller has participated in the NGATS planning effort of JPDO.

At a more senior level, in May 2005, NATCA President John Carr sought and was given a seat on the IMC, which oversees the policy and recommendations of the NGATS Institute. The Institute itself is the mechanism for incorporating the views of stakeholders from private industry, State and local governments, and academia into the work of JPDO. Mr. Carr subsequently notified the IMC that he could not attend the meetings. On December 14, 2005, he was notified by the IMC that he had been removed for lack of attendance at the IMC's meetings. According to JPDO officials, the IMC has left a seat open in hopes that the controllers will participate in NGATS after a new labor-management agreement between NATCA and FAA has been settled.

We believe that adequate stakeholder participation in the planning and development of NGATS is critical. In particular, the participation of current air traffic controllers is important because NGATS will likely involve major technological and operational changes that will affect their work. Our work on FAA's current air traffic control modernization program has shown that without early and continuing stakeholder input, costly rework and delays can occur late in system development. Similarly, the input of active controllers on JPDO's planned research—especially on how controllers interact with pilots and air traffic systems in a highly automated environment—can help to identify potential safety issues early, before costly changes become necessary. Controllers' input could also inform JPDO's analyses of issues such as timeliness, cost-effectiveness, and the safe transformation of the Nation's air traffic control system.

Questions submitted by Representative Jim Costa

Q1. Does the JPDO believe that the Next Generation Air Transportation System (NGATS) will be able to handle three times today's traffic if the Nation's major airports are not modernized as well?

A1. JPDO will have to consider several issues related to airport capacity. JPDO's Evaluation and Analysis Division has modeled the capacity of the national airspace system (NAS) and found that the 35 largest airports will be a critical factor in limiting the capacity of the NAS as they reach their saturation points. JPDO models indicate that capacity at almost half of these 35 airports will be limited.

While JPDO expects to add runways at some of these large airports and increase the use of nearby secondary airports, JPDO anticipates that this solution still leaves airport capacity 12 percent below that needed to accommodate a three-fold increase. Moreover, increased use of secondary airports could raise environmental and infrastructure issues. For example, local residents could object to increased noise, and travelers could have concerns about transportation to and from these airports.

JPDO's Airport IPT has been considering how airport capacity can be expanded. While JPDO and FAA are integrating JPDO's NGATS plan and FAA's Operational Evolution Plan into one plan, an official told us that the ability of JPDO to enhance airport capacity is still limited because enhancement decisions are made at the State and local level. The official also noted that JPDO cannot channel federal funds from the Airport Improvement Program to airports where capacity expansion is most needed.

Q2. How will the NGATS be able to mitigate the impact severe weather has on the system?

A2. The NGATS will never be able to completely address the impact of severe weather on the NAS, but could mitigate the impact. Currently, FAA holds daily con-

ference calls to attempt to manage the flow of air traffic during the spring and summer thunderstorm season, but those efforts are hampered by inconsistent data and forecasts. Fast moving thunderstorms, which are difficult to predict with the required precision to support aviation operations, can needlessly ground aircraft thousands of miles away resulting in flight delays and cancellations. JPDO estimates that 60 percent of weather delays are potentially avoidable.

Although in NGATS, aircraft will still need to navigate around the most severe weather events, JPDO expects that NGATS will be able to better manage the problem that severe weather poses to the flow of air traffic. To this end, JPDO and its partner agencies are undertaking several initiatives. For example, JPDO's Evaluation and Analysis division is developing computer models to forecast the results of storms to show how they would affect capacity around an airport. The Weather IPT is studying aircraft systems that would help reduce the effects of turbulence on the aircraft and passengers. The Department of Defense, FAA, NASA, and NOAA are working to combine an array of weather data into one real-time weather picture by using data from tens of thousands of global weather observations and sensor reports from ground, air, and space-based sources. The expectation is that every aircraft will become a node in the NGATS network, thereby ensuring that all users of the system have access to the same sensory-rich information. Sensors will help produce computerized forecasts that will improve forecasting, thereby providing more usable airspace around storms.

Q3. Keeping in mind that nearly all of today's delays are due to severe weather, runway limitations, and over scheduling: Is it reasonable for us to believe that the billions of dollars the JPDO's proposals are sure to cost in the implementation of the NGATS will solve the delay problems we already face today?

A3. It is doubtful that JPDO's efforts will completely eliminate delays, especially when they are weather-related, but we and others have reported that maintaining the status quo will result in gridlock and significant losses to the Nation's economy if airspace demand triples by 2025. JPDO is seeking a variety of solutions to increase capacity and efficiency throughout the system.

As noted in the NGATS Integrated Plan, there has never been a transformation effort similar to this one with as many stakeholders and as broad in scope. Through collaboration and new technologies, JPDO hopes to meet the challenge of projected demand that will soon surpass the current system's capacity. This involves an entirely new approach—one that uses modern communication technologies, advanced computers, precision plotting through the global positioning system (GPS), and modern computer-based decision-assistance programs. For example, JPDO is developing more precise ways to manage the impact of bad weather. Through the Weather IPT, JPDO is employing extensive computer modeling to develop better predictive forecasts to help pilots avoid bad weather. Improvements in forecasts will allow pilots and controllers to more precisely pinpoint severe weather.

In addition, FAA is revamping its Operational Evolution Plan to enhance capacity at the Nation's 35 largest airports so that its scope and time frames for accomplishments are more consistent with JPDO's. To maximize runway usage, JPDO is planning to build on FAA programs that permit planes to land on some parallel runways in low visibility conditions. Low visibility currently eliminates the use of parallel approaches and landings at some airports, which reduces capacity.

Some airports present unique challenges. For example, LaGuardia cannot build more runways due to space constraints. For such airports, JPDO is considering administrative options, such as limiting the number of takeoffs and landings at peak hours, or permitting only certain types of aircraft to land there. JPDO is also considering market-based options, such as charging a premium to land during peak usage time.

Q4. What does the JPDO see as the most urgent problem that needs to be addressed in the near future, not 25 years down the road?

A4. Several near-term challenges facing the NGATS effort were identified by JPDO officials and other participants in a recent public meeting of the NGATS Institute. A number of participants mentioned that development of a cost estimate for NGATS is critical, since Congress needs to understand what it will take to fund NGATS. Another challenge identified was institutionalizing the collaborative processes established by JPDO. Given the 2025 time frame and the complexity of the effort, it is important that JPDO be able to withstand changes in staffing and administrations. Institutionalizing the collaborative process in the short-term will strengthen the ability to achieve success in the long-term.

Another near-term challenge identified by a meeting participant was the need to effectively communicate the importance of the transition from the current system

to NGATS. An NGATS official noted that the American public needs to be educated about the effects of not going forward with this transition. Raising the awareness and support of policy-makers about NGATS now, while it is in the planning stages, could lead to a more proactive and cost-effective transition in the long run.

One challenge—establishing the credibility of the NGATS effort—was mentioned at the public meeting as well as at an expert panel that we conducted in March 2006 to discuss JPDO and NGATS. As we have previously stated, although FAA is now doing a better job of meeting milestones with its major air traffic control acquisition programs, earlier attempts at modernizing the NAS encountered many difficulties. JPDO will need to show non-federal stakeholders that the NGATS effort, while complex, is moving forward and has the commitment of the partner agencies behind it. Establishing the Federal Government's commitment to NGATS should help JPDO to maintain the interest and enthusiasm of non-federal stakeholders who are participating on a *pro bono* basis in the NGATS effort.